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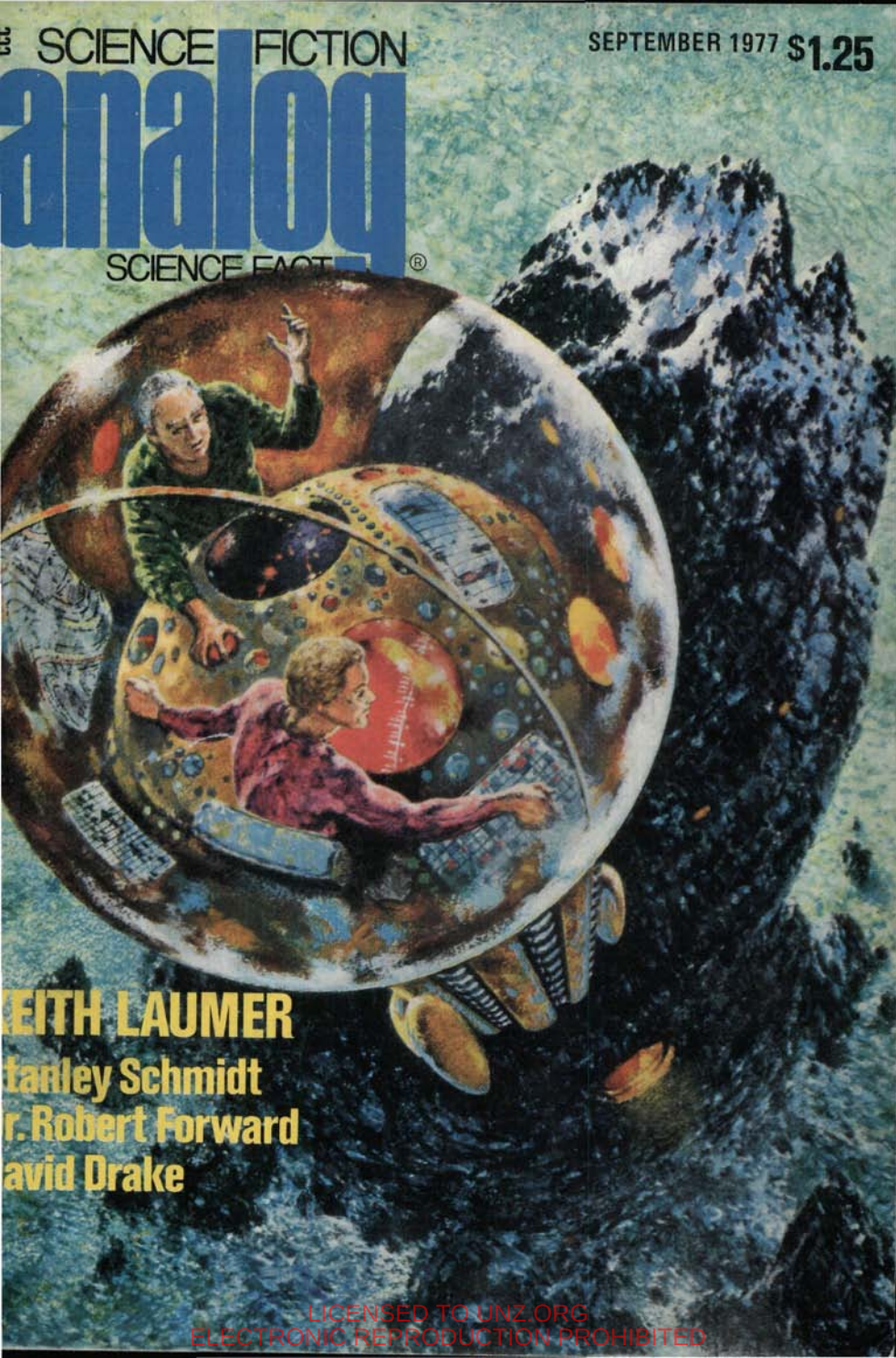

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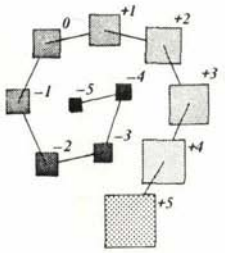

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problem grokking

Science fiction people tend to be problem-solvers. Most of the readers of Analog seem to have pragmatic, practical minds. They tend to seek out answers to questions, solutions to problems.

Many years ago, John Campbell typed a letter in response to a writer who had sent in a hopelessly downbeat story, with an unresolved, blackly pessimistic ending. Campbell finished his rejection letter with this line: "State your problem—*but solve it!*"

We still use that letter here at Analog as a standard response to needlessly downbeat stories. But what if everyone were encouraged to face their problems that way? There has been enough wailing in the media about national and international problems to convince even some optimists that the end of the world is just around the corner. Every day we hear more cries of despair over energy shortages, pollution, unemployment, racial strife, death and taxes.

We've seen the problems, over and over again. When are the media going to show us some of the answers?

For example:

When the United States extended its territorial claims out to 200 miles from our coastlines, there were stories in the media about how difficult it will be for the Coast Guard to patrol this enormous area. It is the Coast Guard's job to make certain that our territorial claims are enforced. How could their relatively few patrol cutters and aircraft spot foreign fishing vessels or other poachers in our territory?

While Coast Guard officers moaned for the news cameras, no one suggested that a single snapshot from a satellite camera could tell us exactly which ships were where. Reconnaissance satellites have been providing such information for the U.S. Navy routinely for years now. There is no reason why satellite photos could not give the Coast Guard up-to-the-hour "traffic reports" on the ships in our territorial waters.

A cynic might suppose that certain bureaucrats were using the 200-mile "problem" as a lever to get more

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money, prestige, or manpower for the Coast Guard. If *that* was the problem, the satellite photographs will solve *it*, too. But not in the way the bureaucrats wanted.

To find an effective solution to any problem, it is important to understand the problem in its entirety. You don't destroy icebergs (to use a Coast Guard metaphor) by shooting off the part that's above the waterline. As a Robert A. Heinlein character might put it, we must be able to *grok* the problem in its fullness.

Take the war between France and the Borough of Queens, for instance.

Britain and France, cobuilders of the Concorde SST, want desperately to have their plane operate out of JFK Airport in Queens. The residents of Queens want no part of the supernoisy supersonic jet. While the British exerted polite but firm diplomatic pressure at vital American political points, the French—with classic Gallic *élan*—virtually declared war on Queens. French politicians, including President Giscard d'Estaing, insulted the residents of Queens, French newspapers ran tirades about how selfish Americans have always been (Always? Even in 1944?), and a cloud of lobbyists and public relations flaks descended upon Washington and New York.

As this is being written, a federal judge has ruled that the New York Port Authority, which controls JFK, has no right to ban the Concorde from the airport. The good burghers of Queens are staging massive protests, blocking the airport with thousands of automobiles. They swear they will sit on the runways, if necessary, to prevent the Concorde from landing.

That's the problem. What's the solution?

Look at the whole problem. *Grok* it in fullness. The French and British have sunk enormous funding and national prestige into the Concorde. French and British workers have been told, and no doubt believe, that thousands of jobs are dependent on the success of the SST. And the Concorde's success, they are further told, depends on the availability of the busy and lucrative New York area market. Without New York, the Concorde is ruined. Therefore the pressure on Queens.

But look further. The Concorde is a badly inefficient commercial airplane. Even at ticket prices nearly double the usual transatlantic fares, the Concorde loses money. It is really prestige that is at stake here, more than jobs or money.

So why not compromise? Let the Concorde land at JFK, or any other American airport, for that matter, providing the British and French agree to keep the plane in service at each airport for a minimum of five years. Since each flight costs more than the plane's ticket sales recoup, within those five years the Concorde, Air France, and British Airways will all be broke, and they will never hurt the eardrums of an American citizen again. The residents of Queens may have to put up with a lot of noise for

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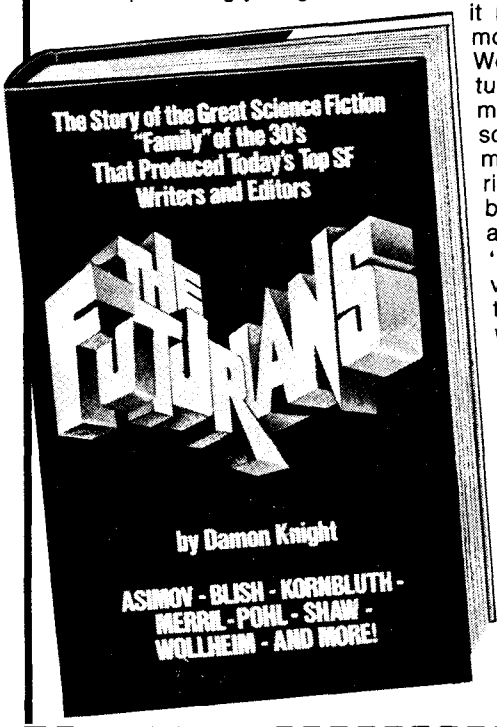
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those five years, but they will have the satisfaction of inexorable revenge.

We could go on for hours in the same vein. Once you *grok* the problem completely, the answer becomes apparent.

The president of General Motors, facing a panel of reporters on a CBS-TV "Face the Nation" broadcast last May, stoutly tried to convince his interrogators and the American public that big cars are a necessity, and Americans should buy only American-made cars. But he wasn't facing the problem! The real problem is that there won't be any gasoline for cars within another generation. How do you run an automobile industry without fuel. That's the problem facing GM as well as Toyota.

There has been a loud hue and cry over the problem of illegal immigrants in the U.S. Nearly eight million (or twelve, if you believe some reports) aliens are living in the States, either displacing American citizens from jobs or soaking up American welfare and/or unemployment benefits. How to catch them? What to do about them? How to prevent the steady flood of still more illegal immigrants who are entering this nation by the thousands each month?

Look at the whole problem.

These people come to the United States for better economic opportunities: jobs. They want to feed themselves and their families, and America is still the golden land of opportunity, especially compared to the systemic poverty of nations such as Mexico.

The illegal immigrants are usually paid the lowest possible wages by unscrupulous employers who don't give a damn what happens to anyone, as long as they can squeeze more profits out of their illegal labor force. From New York restaurants to California farms, illegal immigrants are working at wages that American citizens (and taxpayers) consider demeaning. For the aliens, any salary is better than no salary, and they are in no position to demand their economic rights.

The answer? Instead of trying to catch the aliens and deport them, encourage them to report on their employers' illegal practices. Offer amnesties and American citizenship in exchange for such information, just as we offer rewards for information in criminal cases. Then use the Internal Revenue Service to deal with the employers who are paying illegal low wages. If there were no "wetback" wages, employers would have no reason for hiring aliens over citizens. And if an illegal immigrant has the opportunity to become a citizen and work at a decent American wage, he or she would then be on *our* side and help to spot and stop the influx of more illegal immigrants.

A final problem and its potential solution:

Many American voters agonize over their choice at election day, especially when there is a Presidency at stake. Usually the choice is made on emotional grounds: one candidate makes better speeches than the other,

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or cuts a better television image, or belongs to the political party that the voter feels committed to. Most often a President is elected because the voters didn't like his opponent. The "votes against" are usually the decisive ones.

Hardly any voter bothers to look at the party platforms that the candidates represent, for two reasons. First, most of the platforms seem alike, both in their general shape and in their vagueness. Second, most voters feel that the candidates won't bother to enact the policies represented by the platforms, once elected.

But what if some bright computer people took those platforms and fed them into the kind of program that was developed at MIT and used for the Club of Rome studies, such as "The Limits to Growth?"

If computer simulations can make reasonably accurate forecasts of world industrial production, population growth, pollution levels, and resource depletions, why can't computer simulations show the voting public how each party's platform would affect taxes, gross national product, employment, defense capability, industrial output, etc?

Going a bit further, why not an ongoing computer simulation that gives forecasts on the effects of each bill before the Congress on the leading national indicators of economic well-being? There is no reason why a computer cannot be programmed to show how a new bill on, say, a waterways project would affect employment, pollution, tax structure, et al.

Naturally, computer simulations are only simulations, and "garbage in—garbage out" is still the watchword. But it might be incredibly instructive to see—even in rough simulation—what effect a national party's platform would have on the nation's future. It might be marvelously beneficial to have some concrete idea of how the bills before the Congress would affect our individual well-being.

We have the technology to do this. Perhaps we will never be able to see our political problems "in fullness" until we do.

THE EDITOR

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"John Henry said to the Captain,
A man ain't nothin' but a man . . . .' "

Keith Laumer

Part I

A man walked slowly along a darkened street. He was a young man, conservatively attired in a dark blue double-breasted blazer, gray bell-bottoms, a bright blue shirt with a wide regimental tie. But he moved like a man of eighty, holding his elbow pressed tightly to his side. His name was Damocles Montgomerie and he had been shot at close range by a .32-caliber Baretta automatic pistol, the bullet having broken two ribs and driven a dozen bone splinters into his liver before coming to rest half an inch from his spine.

Reaching an alley mouth, he half-turned, half-fell into the shadowy space between corroded brick walls. A garbage-can lid clattered on oily cobbles. He braced himself against the wall, pushed himself upright, and went on, deeper into the reek of garbage. Reaching the end of the *cul de sac,* he turned, put his back to the wall. With his fingers, he explored the hot, damp area below the ribs on the right side. There was a neat hole in the thick flannel of the coat, a hole which continued on through the heavy silk shirt and the fitted undershirt into the flesh beneath.

A step sounded softly from the direction of the alley mouth. The beam of a flashlight speared out, traversed the pavement, played up the wall and across Montgomerie's chest, moved to his face. It held there for a moment and then winked out.

"Where you want it, punk?" a soft, hoarse voice rasped. "Between the eyes suit you OK?"

"Better try a gut shot, Chico," Montgomerie said in a voice as thin and taut as a stretched wire. "I don't trust your aim."

"Save it, rat. You got five seconds to square it with the man upstairs. One . . ."

He listened to the count. It seemed to go on and on. Then it reached five. Light blossomed from the muzzle of the gun, illuminating the scene with a warm, yellow glow. The plume of flame elongated, ringed with viscid smoke which slowed, stiffened into immobility. The killer stood, feet apart, leaning forward, his left arm out, fingers spread, the gun in his right fist thrust out before him. His lips were pulled back from his teeth; his eyes were half-closed, intent, unmoving. . . .

Behind him, something stirred near the alley mouth. A slightly-built man in a gray derby and a dapper morning coat complete with Ascot tie and boutonniere was picking his way fastidiously back toward the little tableau so curiously arrested. His face—visible by its own pale glow—was narrow,

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elderly, prim, with a neatly groomed hairline moustache. He swung a slim silver-headed cane from one pigskin-gloved hand, glanced curiously at the immobile gunner as he edged past him, came to a halt before the injured man. He looked him over assessingly, his lips pursed in an expression of mild disapproval.

You seem to have managed your affairs very badly, my lad, a perfectly clear voice spoke inside Montgomerie's head.

He tried to speak; nothing happened. He tried to move: same result.

Tush, no need to grow excited. Nothing will happen to you that hasn't happened to uncounted billions of other organisms in the short history of the planet.

HELP, Montgomerie yelled silently. GET ME OUT OF HERE.

Exactly my intention, my boy. Simply be calm. In fact . . . it might be as well if you'd just drop off to sleep.

A heavy curtain of drowsiness wrapped itself around Montgomerie's thoughts. He was dimly aware of the old gentleman stepping briskly closer, clamping him under an arm, and walking up into the air. He caught one fading glimpse of tarred rooftops, ventilators, TV antennas, dropping away below. Then he let it all go and slid, faster and faster, down into the bottomless vortex of unconsciousness.

This, Damocles reflected contentedly, *is what I call living. Snoozing away in a first-class seat on a luxury airliner, bound for the hot spots of gay Paree. Out the window, the Moon will be shining down on the billows, and in a second or two the stewardess will ease up to me and say . . .*

"Care for a sandwich, lad?" said a ratchety male voice. Montgomerie's eyes flew open. He was in a tiny room, seated in a semireclining chair before a curved surface of black glass. Below the glass was a cluster of bright-colored knobs. On one of the knobs rested a thin, veined hand. The hand was attached to a crisp white French cuff which emerged from a well-pressed black sleeve, which led inevitably up along an arm to a gently smiling, wizened face with thin white hair and a fingernail moustache.

"You . . . !" Dammy piped in a voice like a baby bird. "But . . ."

"You were perhaps hoping to see Chico?"

"Chico!" Dammy winced, and felt a pang in his side. He fingered the site of the bullet wound, felt smooth, thick padding. "I thought—how—what?"

"Don't trouble yourself, Damocles. I've sealed the puncture and given you a temporary metabolic hold to prevent further deterioration in your condition until I can whisk you into the automed. In the meantime, a bite to eat will no doubt reinforce your sense of security."

"What sense of security?" Montgomerie chirped, and paused to rest. "I thought I dreamed you. While I was dying, I mean."

"Ummm, not precisely. You perceived me with a portion of your cerebrum not usually activated in the

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waking state—but this is a side effect of the stasis field, no doubt."

"You're not—the Angel Gabriel, or anybody like that?"

"Another branch of the service entirely. Would you prefer pastrami, corned beef, or Swiss cheese?"

"Wait a minute," Dammy expostulated. "Just hold on a minute. Who are you? Where am I? How did I get here? And—"

"You may call me Xorialle. You're aboard my cycler. I brought you here."

" 'Sorry Al'. That's not much of a name. I'll just call you Al, OK?" Dammy closed his eyes tightly. "I got shot. That's definite. It hurts." He gave his side a prod to reassure himself. "After that, I was in an alley . . . and Chico . . ." He paused to swallow. "Funny, I never figured you'd have time to see the flash from the slug that blew your brains out. But . . ." He fingered his head. "At that range—how could he miss?"

"He didn't," Xorialle said. "That is to say, the bullet was projected along a path intersecting the point in space occupied a moment before by your left eye, and continuing doubtless to impact against the wall."

Dammy's hand went involuntarily to his eye. It seemed intact.

"Uh-uh," he said. "I don't believe that life-after-death theory, Al."

"Of course," Xorialle continued, "by the time the bullet left the gun you were no longer there."

"I . . . ducked?"

"Not at all, my dear fellow. I removed you from the line of fire. If it weren't for my intervention, your existence as a conscious intellect would have been terminated twelve minutes ago."

"Yeah, but how could you? I mean, I saw you coming. And after that . . . I was floating in the air; and the gun—"

"I suppose you're referring to the other side effects of the stasis field. It was necessary, you know. I don't have the facilities for reconstructing cerebra; I need you intact."

"Hold it right there," Dammy cut in. "If this is your idea of a job offer, forget it. I work alone. If you had something to do with . . . what happened back there, OK, thanks. I don't get it, but that's OK too. So I'll just be on my way now, and—"

"And be dead in six hours," Xorialle said casually. "Your liver, you know. Can't function very well with a quarter-ounce of copper-jacketed lead in it. Quite inoperable by local techniques, of course. Your only hope is my automed."

"You a doctor?" Dammy inquired weakly.

"You may be assured your case is well within my competence."

"How do I know you're not lying?"

"Hmmm. I've been suppressing the symptoms of your injury. Possibly that's given you a false sense of well-being . . ."

Someone lit a match in Dammy's gizzard. It flared up, ignited a large wad of excelsior someone had left

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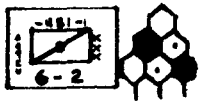

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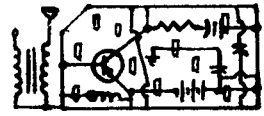

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lying in the vicinity. He opened his mouth to yell and the fire winked out and was gone as if it had never been.

"That's how you'd feel if I weren't, er, handling your case," Xorialle said crisply. "Shall I continue?"

"I was going to ask you how you did that," Dammy gasped. "But never mind. I wouldn't understand the answer. Let's get going to the hospital."

"ETA approximately forty-five minutes," the oldster said briskly.

"How do you get out of here?" Dammy was groping at the strap holding him to his chair.

"I wouldn't suggest releasing the harness," Xorialle said casually. "We're at five hundred thousand feet, traveling at approximately Mach 7."

Montgomerie clutched for support. "I don't believe a word of it," he said, and swallowed hard. "We're standing still. I'm scared of airplanes. That is, I would be if I'd ever been in one. There's nothing holding them up. And I don't know much about it, maybe, but I know they make plenty of rocket, and—"

"At one hundred miles altitude there's no air to speak of, hence no turbulence, no rush of wind. And since the cycler's engines are silent, quite naturally you hear nothing."

"Where's my p-parachute?" Dammy inquired in a voice that had a distressing tendency to slip into a falsetto.

"My boy, if you should, through some malfunction of the safety interlocks, manage to eject yourself from the cycler, you'd be shredded into ribbons and toasted to a crisp before you fell halfway to the surface. I'm afraid a parachute wouldn't help."

"That makes me feel a lot better," Dammy said in a tightly controlled voice. "If it wasn't for a couple things like Chico's gun and that little trick you did with my insides a minute ago, I'd call your bluff."

"No bluff, my lad. Simply accept the fact that your life has been fortuitously extended, and conduct yourself accordingly."

"Where are we going? We must be halfway to the North Pole by now."

"We'll be there in thirty-two minutes and twelve point four seconds, to be precise," Xorialle said. "You'll see it shortly. In the meantime—what about a Bavarian ham on rye and a cold glass of Pilsner?"

The rock thrust up out of the Arctic Sea—a hundred-yard-high boulder alone in the vast whitecapped sweep of frigid ink-black ocean, crowned by a cluster of lights that sprang into being in response to a button poked by Xorialle as he maneuvered the cycler down from the heights.

"Kind of isolated, isn't it?" Montgomerie inquired rhetorically, noting the slow wash of breakers at the base of the outcropping.

"My work requires a certain exclusiveness," Xorialle explained offhandedly. "Far better to choose a spot where one is unlikely to be disturbed than to be put to the bother of disposing of intruders, which frequently

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leads to more trespassers in search of the original ones, and more disposals."

Dammy gave Xorialle a searching look.

"Disposals, huh?"

"Quite humanely, of course—to employ the word in its theoretical sense." Xorialle gave Montgomerie a friendly smile. "No offense intended to your young race, of course."

"What's my race got to do with it? I'm as blue-eyed and sandy-haired as the next guy."

"Everything, my boy, everything. But I'll make all that clear to you very soon—after I've attended to repairing your hurts."

The craft settled smoothly toward a circular opening that irised wide to receive them. Walls rose around them; the cycler touched with a faint jar and was still. Xorialle touched a button and the hatch popped open. Dammy, braced for an icy blast, felt only the soft caress of a tropical night, laden with the aroma of frangipani and magnolias and a faint melody of Hawaiian guitars. He stepped down, favoring his punctured side, gazed around mutely at the flowerbeds, terraces, pool, and palms. Above him spread what appeared to be an ordinary Tahitian night sky.

"Do you find the environment congenial?" Xorialle said with a note of concern.

"If you mean do I like the layout, yeah, it's OK."

"Splendid; now we'd best hurry along to the laboratory. That metabolic hold won't keep you alive forever."

Dammy started to ask a question, but at that moment his words were cut off by a twinge probably resembling the sensation experienced by a vampire when impaled by a stake. He suppressed a groan and followed the old man across the patio, through a wide doorless arch and along a green-tiled passage to a walnut slab door which opened on a chamber asparkle with white enamel and polished chrome.

"You find the decorative scheme reassuring, I trust?" Xorialle said with a note of pride. "I assure you no expense has been spared to reproduce an authentic setting, complete with full sensory stimuli."

"At least it doesn't smell like a hospital," Dammy commented.

"Eh? Oh, to be sure." Xorialle turned and touched a button. The acrid reek of ether, carbolic acid, poached eggs, and deodorant sprang instantly into being.

"Soothing, isn't it, my boy? In such surroundings, associated with the infallibility of your surgical experts, all your primitive fears are laid at rest. Now this—" Dammy's host punched another button and an assembly resembling a morgue slab under attack by a week's production of a cutlery factory deployed from the wall. "This is the automed, a masterpiece of ingenuity, adaptable to a vast variety of life forms including your own—and entirely physical-based, you understand. No subjective input required,

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making possible its use with subaware forms, luckily. Just stretch out here, and we'll soon have you right as rain."

"Where's the nurse?" Dammy demanded, hanging back.

"Ah, yes, the presence of a nubile female of your species would be useful, to inspire a show of manly stoicism."

"Skip it," Dammy muttered. He was beginning to feel dizzy and weak. The warm, numb feeling in his side was wearing thin, allowing the sharp edges of something beneath to jab at his vitals in a tentative way.

A hand swam out of the gathering mist to grip Montgomerie's arm. He allowed himself to be led forward, was vaguely aware of lying down on his back, of the touch of metal—not cold, but at body heat. . . .

Then blackness as soft as soot and cobwebs folded down on him and blanketed out all thought. . . .

This time his awakening was more leisurely. He lay for a while savoring the sensation of crisp sheets and a soft mattress, aware of the scent of broiling bacon and percolating coffee, enjoying a general feeling of utter well-being. Then his sense of reality rallied.

Yeah—I'm probably lying on my back in that alley with a slug in my skull, dreaming all this—like I dreamed the little guy with the magic airplane and the carnation in his buttonhole. My best bet is to just lie easy and not make a wave, and hold onto the hallucination as long as I can, because when it wears off. . . .

"Awake, I see," a cheery, elderly voice spoke close at hand. Xorialle stood beside the bed, casually attired in a lemon yellow terry-cloth jacket and shorts, a large Gene Autry watch with a wide yellow plastic band on his skinny wrist.

"Hey," Dammy said weakly. "You're real. . . . "

"We've already been over that," the old fellow said with a touch of severity. "As you know quite well. But I suppose it reassures you to periodically reinforce your self-image of non-gullibility."

"How did . . . the operation go?"

"Why, as programmed, of course. Why do you ask? You feel well, I assume?"

"Not too bad," Dammy said weakly.

"I thought we'd start the day with a swim," Xorialle said briskly. "Not only refreshing, but a useful opportunity to assess just what it is I have to work with, coordination and endurance-wise."

"Are you kidding?" Dammy said with a break in his voice. "I'm good for at least two weeks flat on my back with radio music, artificial flowers, meals in bed, and pillow-fluffing once an hour."

"Yes, I'm sure you'd find those rituals comforting; but unfortunately time is of the essence. I'm sure you're rational enough to dispense with some of your traditional ceremonials—"

"Ceremonials, my Uncle Gertrude!

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I've been shot and sliced open and sewed up, and the Confederate cavalry wouldn't get me out of this bed for at least, say, ten days!"

"Tsk. Old ideas *do* die hard. Pull up your nightshirt, Damocles, and examine your wound."

"Skip it. I can't even watch when I get a smallpox vaccination."

"See here, my boy, you have to make some minimal effort to discount the purely instinctive element in your behavior. Kindly do as I request."

"Or you'll give me an ulcer, I guess," Dammy said sullenly; but he complied with instructions. The smooth hide over his ribs was unmarred by so much as a mole.

"Uh . . . I guess it was the other side," he said, and pulled the garment away to expose a matching expanse of unblemished skin on the left.

"Well?" Xorialle said with studied patience. "I trust you're satisfied?"

Montgomerie rubbed his chin ruefully. "That was the realest dream I ever had," he said. "I would have sworn I took a slug in the short ribs, dragged myself to my jalopy, drove home, left again, walked two blocks, got ambushed in an alley, and—well, after that it gets kind of silly." He managed a wry smile. "So maybe I've been working too hard. The laugh's on me . . ." The smile faded, metamorphosed into a frown. "Either I've gone nuts, or all this is really happening. If I'm nuts, I'll be the last to know. So I might as well act as if everything was just the way it looks."

"Come, Damocles: your pretense of imagining me to be a figure of fantasy wears thin. Accept the situation; don't fight the problem—solve it."

"Yeah. If I dreamed the whole thing—who does that make you? And how did I get here—wherever here is? And where are my clothes?"

"Suitable garments have been provided." Xorialle slid back a closet door to reveal a number of neat tunic-and-shorts outfits.

"I mean my real clothes, I can't go out of here in a pink kimono."

"I suspected the items would have emotional attachments. They've been cleaned and repaired and placed in your permanent quarters."

Dammy threw back the light blanket, walked to the curtained window and looked out. A vista of blue-black ocean, white-flecked, stretched to the far horizon. There was nothing else in view.

"I'm really here—at the North Pole—and you really patched a hole in my side without even a scar?"

"That's more or less correct, Damocles."

"How long was I out? I'll bet I've been under drugs for a couple months while you did plastic surgery, or—"

"Approximately seven hours and twenty-five minutes. Since the repairs to your liver, that is."

"Nobody heals that fast," Dammy said without conviction.

"You did," Xorialle pointed out. "And while you were comatose I gave you a thorough purging. You're healthier than you've ever before been in your life. Come along; I'll show you

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around the place. I think you'll find it interesting."

Xorialle led the way along a wide, gray-carpeted corridor to a spacious oak-paneled lounge with a magnificent view of the Arctic Sea. Wall shelves were filled with books; there were low tables and big soft chairs, handsome paintings on the walls. Double doors at one side opened into a dining room complete with long mahogany table and sideboard, crystal chandelier, ornately carved chair-backs, and silver candelabra. The kitchens lay beyond: a symphony of gleaming stainless steel and pale yellow cabinet tops, bright with sunlight and potted flowers.

"Class," Dammy acknowledged. "Where's the hired help?"

"I have no servants; none are needed. All necessary functions are performed automatically."

"You live here alone?"

"I'm not affected by such problems as loneliness or ennui, I'm happy to say." Montgomerie's host pointed out the pantry, its shelves well stocked with familiar canned and bottled goods, its capacious freezers loaded with meats and fruits.

"None of this is essential, of course," he conceded. "The foodstuffs might more efficiently be stored out of sight—or more logically, synthesized as needed; but it amuses me to live in native style, and of course I was expecting a guest."

"Guest, huh? Funny, I don't remember getting an invitation."

"Dammy, kindly don't attempt to dramatize the situation by imagining sinister overtones. I've shown you nothing but kindness; I tended your hurts, you can't deny. Just relax and let's be friends."

"OK, Doc. Shake." Xorialle took Montgomerie's proffered hand.

They descended a handsome spiral staircase to the level below, which was given over to offices and what looked like small classrooms, each equipped with specialized apparatus of curious design.

"Training aids," Xorialle explained succinctly. "You'll be seeing more of this soon."

The next level was devoted to sound-muffled rooms with capacious chairs, racks of what appeared to be tape cassettes, film reels, and other objects, of unfamiliar shape.

"The library and data facilities are as complete as any outside Data Central," Xorialle said with a note of pride, "and are updated continuously with inputs both from local sources and, ah, others."

"A library with no books," Dammy said. "It's a switch. What's that?" he pointed to a small, hooded apparatus occupying a niche of its own. Adjacent to it were vertical channels in which glossy half-inch cubes were stacked like gum in a dispensing machine.

"Foreign-language technical data of no interest to you," Xorialle said shortly. "Don't take offense, my boy," he added sternly, "but on no account must you tamper with this section. I

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emphasize: off limits, Dammy. Don't touch! If you wish anything to read, my boy, you'll find it here . . ." he concluded more mildly. He led Montgomerie across to an alcove with a row of buttons above a frosted glass plate.

"All your familiar literary treasures are here, from *The Wind in the Willows* to the *Congressional Record,* current as of this afternoon's session. Merely select from the catalog . . ." He pressed a button and a list of titles appeared on the screen, moving downward with increasing speed as he twisted a control knob. "And the work will be either projected here, or a copy produced for your use." He poked buttons, the machine whirred softly, and a handsomely-bound copy of *Forever Amber* dropped from a slot.

Dammy grunted.

A small elevator took them to the level below. There were no windows here. Narrow corridors led between blank walls, ending at massive doors.

"Utility functions are handled here," Xorialle explained. "The various units are sealed and perform their functions, including self-repair, without supervision."

"Where's your power plant?"

Xorialle shot Dammy a thoughtful look. "Below," he said. "A small fusion cell, using seawater."

"Let's take a look."

"I'm sorry. Off limits. Radiation, you know. Well, that's about it, my boy. Shall we go up?"

"Quite a layout, Doc. It must have cost some real bread to hollow out the whole rock and pack it full of machinery."

"The project hasn't been without expense," Xorialle agreed.

"What's it all for?"

"Later, my boy, later."

Back in the lounge, Xorialle dialed for drinks, which promptly slid into place on the bar. The wind had risen; it boomed against the wide glass areas, transmitting a feel of chill in spite of the comfortable temperature of the luxurious room.

"What happens when a blizzard hits?" Dammy said. "This place sticks up like a cherry on a sundae. These Arctic winds top a hundred and eighty, I heard someplace."

"Have no fear, my boy. This structure has withstood the weather for over three hundred years; I'm sure it will serve as long as it's needed."

"Air conditioning and all, huh?" Dammy glanced sideways at his host. "Pretty fancy for the seventeenth century."

"Don't trouble your head, my boy," Xorialle said offhandedly. "It will all be made clear in due course."

Dammy sampled his drink.

"This place is more than just a little weekend hideaway, right?"

"Quite right."

"You're a funny guy, Doc. You don't say any more than you want to, do you?"

"Do you?"

"Not if I can help it." Montgomerie shook his head. He frowned at Xorialle. "Why'd you bring me here?"

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"To save your life, of course, in the first instance—"

"How'd you know my name?"

"Research."

"Why research me?"

Xorialle spread his hands appealingly. "There was nothing personal, my boy. I required a subject in the early adult years, of average endowments, one whose disappearance from his usual haunts would attract a minimum of notice. My survey turned up a number of possibilities. I selected you."

"For what?"

"As a test subject."

"You with the government?" Montgomerie frowned darkly.

"Not exactly."

"What kind of test?"

"Oh, a standard wide-band evaluation—in your case with the emphasis on potential, of course, since your exploitation of your most recent evolutionary quantum-jump has hardly begun."

"Why is it every question I ask you just gives me more questions to ask?"

"May I offer a word of advice, lad? Don't bother your head at this point. As we go forward with your development—"

"What's that mean?"

"Why, merely that there would be no point in attempting an evaluation based on your present physical and mental condition. We already have your unfortunate culture as ample evidence of your kind's ineptitude at this stage in solving even the most elementary societal problems. What is of interest is the magnitude of the impact you may represent on the Galactic Concensus at your point of maturation."

"Look, Doc, would you do me a favor? Talk ordinary American?"

Xorialle waggled his hands in an exasperated gesture. "I can't quite see what it is you find so difficult to grasp. Naturally, the Concensus monitors developments within the Tessasphere. When a new species emerges onto the psychostratum it's necessary to assess its potentialities in order to determine what, if any, role it should be permitted in Galactic affairs, and in what direction its development should be guided for optimum convergence with Concensual goals."

"That's what I mean," Montgomerie said. "It sounds kind of like American, but it doesn't seem to tell me much."

"Accordingly," Xorialle plowed on, "an average specimen is selected and his innate abilities explored, thus supplying data on which to base extrapolative calculations."

"That word 'specimen'; I thought that was something you gave the lab technician—or stuck a pin through for your butterfly collection."

"Your simple language," Xorialle said sourly, "is rich in encumbering connotations. In this case, you, my boy, are the specimen." He held up a hand to forestall Dammy's comment. "And by determining the extent of your latent capabilities, I acquire, in microcosm, a measure of your kind's

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potential destiny among the . . ."

"What do you mean by 'my kind'?" Dammy said suspiciously. "Is that some kind of crack?"

"Your *kind,* my dear lad; your race, tribe, breed, species, call it what you will."

"You mean American?"

"American, Russian, Zulu, Indio—you're all minor substocks of *Homo sapiens,* as you so naively term yourselves."

"You talk," Dammy said carefully, eyeing Xorialle gingerly, "as if you weren't included."

"I suppose I should have made that point clear earlier," the old gentleman said with a sigh. "You're quite right, of course, Damocles. I am not human."

Dammy edged away from his host. "OK, so you're a Martian," he said. "Just don't get excited. Just keep calm—"

"I'm perfectly calm, I assure you," Xorialle said sharply. "And I am by no means a Martian. My world of origin is some hundred parsecs distant from your minor solar system."

"Sure, whatever you say." Dammy measured with his eyes the distance between them, shifting his weight unobtrusively—

"Don't," Xorialle said wearily. "After such a nice beginning, let's not degrade our relationship back to the lion-tamer level."

Dammy sucked in his breath and jumped—

Or, more correctly, he initiated the neural commands which ordinarily would have expressed themselves in a sharp intake of air and a lithe spring. Instead, he sat unmoving on the same spot. Not a quiver of a muscle reflected the inner turmoil as his somatic indicators responded to the fact that nothing had happened. Then, very slowly, he fell sideways to the floor.

"Sorry," Xorialle said, "I may have pinched a trifle too hard."

"Think nothing of it," Dammy said weakly, struggling to his hands and knees, which were suddenly filled with pins and needles. "I guess I'm not quite as healthy as I thought I was." He groped his way back to the chair, still experiencing the shocking sensation of the *touch* within his mind, the incredible invasion of his most personal inner *me,* by what seemed in retrospect to be a hair-fine tendril which had groped tentatively, then abruptly gripped hard—and thrust *him* aside. Now, as he sat, staring glumly across at his host, he felt the alien presence release its grip and withdraw, leaving behind in Dammy's thoughts a new conceptualization of his mind, compartmented, complex, interconnected in curious ways. He wondered . . .

"See here, Damocles," Xorialle said kindly. "It's necessary for the success of my work that you accept the realities of the situation. I can't directly influence your intellectual processes excessively without damaging the areas I hope to develop: I'm forced to rely on your own vestigial intelligence to perceive the wisdom of cooperation."

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"Look," Dammy said wearily, "I don't know much, maybe, but I know Martians are little green men, not old gents with trick moustaches. If you were some kind of space monster, you'd have bug eyes, tentacles, stuff like that. You wouldn't look like the rich uncle in a late TV movie."

"Why not?" Xorialle inquired with raised eyebrows.

Dammy eyed him shrewdly. "If you came from Outer Space, pops, an oyster would be a closer relative of mine than you."

"Not applicable. The Mollusca occupy an entirely different ecological niche—"

"Or a Hottentot," Dammy said. "Why don't you look like a Bushman, or an Eskimo, or maybe one of those Ayrabs with whiskers down to here?"

"Would you have found that reassuring?"

"What's that got to do with it?"

Xorialle sighed. "It's of the greatest importance that a rapport based on a valid interpersonal relationship be established between us. I naturally assumed a guise calculated to stir as few as possible of your hostility syndromes. By appearing as an elderly and affluent member of your own racial strain, I sought to lay at rest any antipathies due to skin coloration, hair texture, and the rest, while not arousing rivalries based on fancied sexual competitiveness or male dominance factors—"

"You talk like you had some choice," Montgomerie said. "Most guys I know have to settle for what Mother Nature handed them."

Xorialle wagged his head in exasperation. "You're proving unexpectedly resourceful in avoiding acceptance of the facts," he said. "I'd planned to prepare you more gradually—but it appears I'll have to risk the shock on your nervous system somewhat prematurely."

"What shock to my nervous system?" Dammy inquired nervously. "Take it easy, now, Doc; my crazy bone is still twanging like a guitar from your last demonstration."

"The shock of seeing me as I actually am."

"I'm looking at you right now," Dammy said.

"Damocles—I'm in costume," Xorialle said gently.

"So—I've seen fake whiskers before . . ."

"It's more than the hirsute appendages."

"OK, a putty nose, tinted contacts—" He broke off as Xorialle sighed and pressed a point behind his ear. A line appeared, bisecting his face from forehead to chin, running down his neck to disappear beneath the beach jacket. The fissure widened; his face opened like the two halves of a clamshell, exposing something gray-scaled, dull-gleaming inside.

"Have I made my point clear?" his voice issued from the gaping orifice.

Dammy closed his eyes tight and said, "Close it up, close it up, close it up—"

"Very well; you may look now,"

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Xorialle said in a more kindly tone. Montgomerie opened one eye. The old gentleman smiled at him amiably, looking perfectly normal now.

"By the way, pop, what's it like—out there—you know, in the stars and all?"

"I presume you intend to inquire as to conditions in extraterrestrial environments."

"Sure, that's what I said. I mean, how is it out there on Mars and stuff?"

"Damocles," the alien said sternly, "I must caution you that you are to make no effort to acquire data regarding the Concensus. The less you know of such matters, the better for you."

"Cripes, par me, Doc. I didn't mean to step on your corns."

"Any, ah, *other* questions?" Xorialle inquired gently.

"Not, ah, at this time," Dammy said dazedly.

"Splendid. I have a feeling this may turn out to be a most interesting evaluation after all," Xorialle said in tones of satisfaction. "And now—shall we rest a bit—and tomorrow on to your testing."

"Point me toward the bedroom and I'll take it from there," Dammy said, "—no lessons needed."

Xorialle escorted him to a handsomely-appointed chamber and switched on a soft light which illuminated a fawn-colored carpet, pale gold walls, a handsome oak bedstead with a charcoal-and-chocolate spread, matching chairs and drapes at the wide (false?) windows.

"Sleep well, my boy," Xorialle said benignly. He nodded and left, with a cheery goodnight.

Lying in the darkness, Dammy waited five minutes. Then he rose silently and tried the door. It was locked. He frowned thoughtfully and returned to his bed.

Well, Damocles thought, *I don't know. Swell place—and the old boy—or whatever he is—has treated me right, just like he said. But sticking his fingers in my brains like he did gives me the galloping willies. But I guess I can worry about that in the morning.*

On a sudden impulse he rose and went to the closet.

His clothes—not Xorialle's issue outfits—hung there, clean and pressed. Farther back in the far corner of the roomy closet, hung another garment. Dammy examined it: a knee-length coat of coarse blue cloth, with brass buttons and mixed-up lapels. The back-of-the-neck part stood up and folded back in a soft roll, while the lower part lay flat.

Looks like the last guy stayed here dressed like George Washington, Dammy mused. *But Xorialle said I was the only one ever slept in this room. Funny, a guy lying when there's no reason for it. There's more to old Al than he lets on . . .*

Dammy took the flat leather tool kit from a concealed pocket of the blazer he had worn the night he was shot—or not shot. . . . He checked it quickly; everything was there. Either Xorialle had missed it or he hadn't

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looked. Maybe the old boy missed a bet once in a while after all. . . .

It was almost midnight, eight days later. Dammy slumped in a large and handsome contour chair upholstered in glove-soft ochre leather, gazing across the wide and beautifully-appointed lounge toward the wall of glass affording the spectacle of the sun that hung on the horizon, dyeing the sky and sea crimson and purple.

"Well, it's been a busy week," Xorialle said briskly from his perch on a large violet ottoman before the cheery blaze that crackled on the tiled hearth. "But not without result—though there does seem to be a remarkably potent otiosity factor that needs to be compensated for in my calculations."

"That gym," Dammy groaned. "And those flashing lights; and that buzz machine. I don't know whether my head or my back aches worst."

"Worse," Xorialle said. "Precision of diction is vital to accurate communication. As for your imagined pains—dismiss them. They're no more than self-induced tensions—"

"You and your torture machines are what induced them, along with the blisters and the spots before my eyes. This is a lousy way to treat an invalid his first week out of bed."

"Don't fret, Damocles," Xorialle said comfortably. "We've managed to exercise most of your physical and mental faculties sufficiently to give me the bulk of the data I require at present." He frowned thoughtfully. "Frankly, I'm rather surprised. Your nervous system seems to be a very fine instrument indeed, though largely unused, of course. And your physical condition is not at all bad for a specimen whose development has been random, undirected. That's not too surprising, actually; the ideal psychosome, after all, is one perfectly adapted to its environment, and a natural environment will produce a normal animal. Your somewhat irregular habits of life have introduced sufficient variety into your activities to preclude any premature deterioration such as results from a sedentary or overly specialized life-style."

"I could have told you I keep in shape; I work out a couple times a week—"

"Please, my boy," Xorialle said tiredly, "no chest-beating just now. I have the data; anecdotal emendations are quite superfluous."

Montgomerie brightened. "Well, that's something. In that case, I guess you'll be running me back to town in the morning." He waved a hand at the room. "They'll never believe me when I tell them about this setup," he said almost cheerfully. "A luxury penthouse, only more so, a few thousand miles from anywhere. You must have a couple million bucks worth of equipment in the lab and the gym and the kitchen, plus this fancy furniture, the power plant—"

"Ah—Dammy," Xorialle began, but Montgomerie chattered on:

"And I'll get a real lift out of the look on Chico's face when he sees me.

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But on the other hand," he went on more soberly, "I might be smarter to just fade out like Jeannie said, and pick a new home town."

"Damocles," Xorialle cut in, "I'm afraid you've leaped to a faulty conclusion. I won't be running you back in the morning—"

"Oh, tonight, huh? Well, OK. But I was kind of looking forward to another good snooze in that bedroom. I'll give you that. Doc—you've got good mattresses—and the chow is all right too—"

"I'm glad you approve," the old gentleman broke in, "because you'll be enjoying them for some time to come."

Dammy sat up and frowned darkly. "Hey, look," he said. "You been running me ragged all week swinging on ropes and jumping hurdles and holding my breath and marking X's on charts and picking out things that matched and things that didn't match, and memorizing telephone numbers, and I've had it! I'm pooped. I'm not going through another day like this one, I don't care if you plant a blowtorch in my duodenum!"

"Where did you learn that word?"

"I read a few of your books, you know," Dammy said sullenly.

"Well—you continue to surprise me."

Dammy was on his feet now. "This is a free country. You got no right to hold a man prisoner—"

"Odd, I'd gathered the impression you were contemptuous of your tribal taboo structure. But no matter; I assure you I am in no way bound by local custom. My duties require that I act in the best interest of the Concensus, regardless of possible inconvenience to you; surely you see that?"

"I'm leaving in the morning, Doc, and that's final."

"How?"

"Well—," Dammy faltered. "Well, blast it, Doc, it's up to you to get me back! Kidnapping is a federal rap!"

"I saved your life," Xorialle pointed out patiently. "I propose only to make use of a segment of your existence which would have been eliminated but for my intervention."

"You said you were finished. What more do you want out of me?"

"My dear boy, I've completed the preliminary calibration of your body and brain, an inventory of your equipment, so to speak."

"Yeah?"

"Tomorrow the real work begins."

"What work?"

"Training you—of course—as I explained at the beginning."

"Training me how?"

"In every way." Xorialle spread his hands as if stating the obvious.

"You mean—like Certified Public Accountancy and TV Repair?"

"All that, my lad, and much, much more."

"I don't get it, Doc. I didn't apply for night school or answer an ICS ad or sign up for on-the-job training. I've got a high school diploma, for crying into your malted milk! Where'd you get the idea I was on a self-improvement kick?"

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"Not you, Damocles. Me."

"Oh, *you're* training for a Big Pay Job in Radio; I get it—"

"I mean," Xorialle said with precision, "that I intend to develop your every innate faculty to its highest possible potential, to explore every latent talent and ability of your psychosome."

Montgomerie sank back down in the chair.

"Latent," Dammy repeated hesitantly. "That means like what maybe I could do if I tried, only I never tried?"

"Approximately that."

"Like, uh, judo, karate," Dammy said thoughtfully. "Stuff like that?"

"At the beginning we'll acquire the rudimentary techniques already current in your extant embryonic cultures," Xorialle agreed. "Then, of course, we'll move on to totally unexplored areas." He rubbed his hands together briskly. (Dammy wondered for a fleeting moment if they were real hands, or prosthesis with tentacles curled inside them.)

"That's the portion of the work that I find most fascinating, of course," Xorialle continued. "One sometimes discovers quite unexpected capabilities stored away in the genes of the most unlikely organism, waiting to be called forth by circumstance. As for example the Yling of Krako 88, a mud-dwelling species equipped with sonar-type sensory organs, who, it developed, were capable, with training, of direct null-time star communication using the same organs in another mode—a most useful skill, which would have remained forever undiscovered had not one of their number been gathered in by a Concensual sampling team."

"You mean you figure to train me to be some kind of teletype operator?"

Xorialle sighed in exasperation. "Certainly not, Damocles—as I'm sure you realize. These attempts to evade recognition of facts by simplistic verbalizations do you no credit. What your own hidden aptitudes might be, I as yet have little idea. But we'll discover them—have no doubt of that."

"I took a test once," Dammy said thoughtfully, "that was supposed to tell me what career to go into. It said I had a rare talent for hotel management. But it was a hotel management school that gave the test, so maybe that had something to do with it."

"My assessment will probe far deeper," Xorialle stated, placing his (imitation?) fingertips together. "In effect, we'll telescope the next five or ten thousand years of your species' niche-exploration and cultural development into a matter of days."

"Hold it, Doc! If you think you're going to turn me into one of those guys with a bulgy head and little bitty arms and legs, you got a couple of new thinks coming!"

"Damocles, don't be silly. My mission is exploration of the species, not forced evolution. I have no intention of inducing mutation, either along the lines of the laughable stereotype you

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postulate, or any other. I'll simply train you, not change you. A girl who learns shorthand and typing is the same girl; a man who memorizes a poem or masters chess is the same man."

"What was all that about telescoping ten thousand years?" Dammy demanded.

Xorialle shook his head. "Let's not get things out of order, Damocles. First, we'll see to it that you absorb the techniques and abilities already possessed my members of your race—then on to new areas. I should like to begin at once, but I suppose you feel you must sleep first?" He eyed Dammy questioningly. The latter yawned.

After a dreamless night, Damocles met Xorialle at the breakfast table.

"Memory," Xorialle said, "is basic to all learning. We will therefore begin today by perfecting your memory."

It was a dazzling morning, though the light streaming past the curtains was artificial. Master and pupil sat in a breakfast nook at a small table bright with a checkered cloth and gay-colored dishes beside windows from which the curtains were drawn back on a view of a sunny garden under an all but invisible dome. Dammy took another swallow of his second cup of coffee and patted his belt line comfortably.

"My memory's OK, Doc," he said. "Don't worry about that part."

"Indeed? What did you have for breakfast on the eight hundred and twenty-first day of your life? Or last October ninth, for that matter?"

"How do I know?"

"Under hypnosis you'd recall quite clearly. The data are there, my lad—merely inaccessible. The training will consist of improved indexing and retrieval procedures." Dammy's host touched a button and the table cleared itself swiftly and soundlessly.

Dammy looked dubiously at his host.

"Memory is a complex function," Xorialle stated musingly. "Without delving into the details, consider merely the mechanism. Data impinge on your sensory receptors, are relayed to the brain. Some are stored, some held for ready use, others are shunted to the subconscious, some few are discarded. The factor by which the discrimination is made, I call 'interest'. Obviously, if you attempted consciously to record every detail of every passing moment, you'd be faced with impossible overload conditions. At this very moment you're ignoring the bulk of the impressions pouring into your brain—after first assessing them, of course. A sleeping man pays no attention to the clamor of vehicles passing a few feet from his window—but a single creak of a supposedly locked bedroom door will rouse him at once. Waking, your mind performs the same filtering function, not only on what is to be noted, but what is to be stored."

"Sure, but—"

"Most of what I'm now saying, for example, is being shunted to dead

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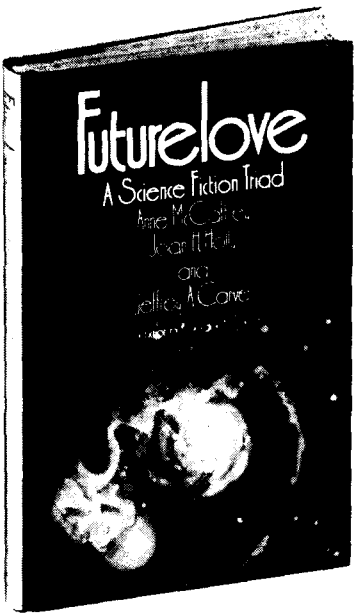

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storage by your brain, since it doesn't interest you. Any child who has ever been forced to memorize the multiplication table is aware of the reluctance of the brain to absorb at a conscious level data which the unreasoning discrimination center says are valueless. Unhappily, the discriminator was evolved to serve the needs of an animal who had no use for arithmetic. You may attempt to flog your reluctant brain on to more effective memorization by telling it that the upcoming exam is vital to your career—but the primitive brain knows nothing of these matters.

"Contrarily, data which are of obvious and immediate interest are remembered instantly, painlessly. Any baseball fan, however dull scholastically, can report at once the status of a game he's watching: inning, score, strike, and ball count, team league standing, batting averages, and so on. A child can follow the identities of the characters and the story lines of dozens of comic strips simultaneously, picking up each one after a twenty-four hour lapse with no difficulty—although he may be totally unable to remember the incidents recounted in a history text."

"So kids like the funnies," Dammy said. "So what?"

"The mind erects barriers to reject the superflous data—the 'uninteresting' data. Only repetition can penetrate those barriers to cut a retrieval path. With the catalyzer, I place the discriminator under your conscious control. Simple?"

"Like a Chinese menu. Will it hurt?"

"You play cards?" Xorialle inquired casually, producing a deck from somewhere in the sleight-of-hand fashion that Dammy had begun to accept as Xorialle's normal manner, rather than an attempt to impress him.

"A little five-card stud now and then. None of that spit-in-the-ocean garbage."

Xorialle shuffled the cards with deft movements of his slender fingers, snapped over the top card, faceup on the table.

"Call it," he said.

"Four of clubs."

"Four of clubs," Xorialle echoed, and turned a second card. It was the ten of diamonds. Dammy said so. Xorialle exposed a third card.

"Hey, I know a spade from a club, if that's what's worrying you," Dammy protested. "And I count like a champ, all the way up to a hundred—"

"Call it," Xorialle said patiently.

"Queen of spades."

"Queen of spades." Xorialle turned the cards out one at a time until he had run through the entire deck. He picked up the stack and turned it over, paused with his fingers on the top card and looked inquiringly at Dammy.

"Come, my boy," he said sharply as Montgomerie stared back at him. "Don't let's waste time with rituals. You know something is expected of you. Anticipate my verbalization."

"I'm supposed to tell you what the first card is?" Dammy guessed indif-

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ferently. "It was the four of clubs—unless you gave me a fast shuffle."

Xorialle turned over the four of clubs and waited, fingers poised over the second card.

"Uh, the uh, ten of, uh, diamonds."

Xorialle turned the card.

"And the Queen of spades," Dammy continued. He called seven cards correctly in sequence before he went blank.

"Not too bad for a first attempt," Xorialle said, folding the deck as soon as Dammy had missed.

"Hold it; keep going," Montgomerie said. "I didn't know I was that good. I can—"

"You've broken the gestalt: the association of each card with the one following. Your calls from this point on will be virtually random, meaningless."

"Let's try that again. I wasn't really concentrating."

The old gentleman gave Dammy a small smile. "Quite exciting, isn't it? Discovering a new ability, I mean. That's what makes life so endlessly stimulating to the very young. Every day they explore their capabilities, discovering facts about themselves. A small boy will sometimes jump into water to *see* if he can swim—or off a roof to learn if flying is included in his innate skills. He's quite used to such discoveries regarding his own strength, social dominance, whistling ability, and so on. As the years pass, such discoveries become rarer. You, for example, know very well you can't ride a horse or pilot an airliner. You know your place in the social pecking order and the sexual competition. Still—you continue to hope for glad surprises to greet you as you go through your days. It's that factor which makes giveaway contests so popular, sends people to palm readers and astrologers for news of unsuspected talents, makes the unwrapping of birthday presents so important a part of the ritual. Always there lurks the unvoiced hope that somehow, under the wrappings lies a wonderful secret—about yourself."

"All that from a deck of cards?"

Xorialle ignored the question and swung a small table out in front of Montgomerie and placed the deck of cards on it.

"Have you ever been hypnotized, Damocles?"

"No—I don't believe in that psychic stuff."

"Tsk. The hypnotic capacity is as normal and commonplace as the ability to sleep—and a good example of an innate capacity that went undiscovered by its possessors until recent years. Rather than chanting formulae, I intend to directly stimulate the portion of your brain normally reached by such methods. Just relax . . ." He returned to the console and touched buttons. Dammy felt a high, faint singing somewhere behind his eyes. The room seemed to change subtly, strike a new balance, become somehow more alive, more immediate than before.

"Turn the first card, my boy." Xo-

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rialle's voice had a strange, faraway, but compelling quality. Montgomerie turned the card.

"Three of spades," he said dreamily.

"Continue."

One by one, he went through the fifty-two cards.

"Shuffle," Xorialle said.

Dammy shuffled the deck.

"For each card of this next run which you call correctly, a magnificent prize awaits you," the old gentleman said solemnly. At once, Dammy felt his heart accelerate. His mouth felt dry. Visions of incredible luck flashed before his eyes. He turned the cards quickly; their patterns seemed vivid, meaningful. He finished . . .

"That's all," Xorialle said. "Revert to normal awareness."

It was as though an impalpably fine mesh gauze dropped over the scene. For a moment, Dammy had a sense of dullness, of numbness. The feeling faded.

"Call the first run," Xorialle said.

Dammy reached for the deck.

"Never mind that," Xorialle said curtly. "Just visualize them."

"Three of . . . spades," Dammy said. He called two more, then drew a blank.

"Call the second run," Xorialle ordered.

Instantly, the mental image of a card snapped into focus. He called the entire deck as rapidly as he could speak.

"Start with the twelfth card." Dammy reeled them off.

"Call them in reverse."

Dammy did it.

"Add three to each number, call face cards in reverse rank, and shift suits in the order spades, hearts, clubs, diamonds."

Dammy recited as required with no loss of speed.

"So much for memory, my lad," Xorialle said brightly. "Your key symbol for total recall is *three of spades*. And by the way, while I was about it I established a self-hypnotic trigger you can employ when needed. Key word: 'prize'."

"How," Dammy said in wonderment, "did I do that?"

"Tell me, could you have memorized the deck, left to your own devices?"

"Sure—I guess—if I went through it a couple dozen times."

"I employed the same process—lubricated a trifle. How many song lyrics do you know?"

"Who, me? I don't go in for—"

"Such effeminate pursuits. I know. Nevertheless, you've heard the words of certain popular tunes over and over; will he, nill he, some of them have lodged in your mind. The average man, if pressed, could recite some dozens of them. Suppose each song includes one hundred words—each word keyed to a distinct note of the scale. Each word in turn consists of an average of six letters. If a message were to be encoded to those letters, using sequence and pitch to carry additional intelligence, a considerable

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amount of information could be transmitted, do you agree?"

"Well, I—"

"Word order itself is a powerful tool. Consider the difference between 'travel time' and 'time travel'. And punctuation: 'This book was dictated by God'—versus 'This book was dictated, by God!'"

"Uh, yeah, but—"

"From now on we'll make use of that waste capacity. Now: let's get on with the refurbishing of your concentration, computational ability, deductive faculties, pattern perception, and so on. The sooner we finish the preliminaries the sooner we can get into the truly substantive portion of the program."

Xorialle looked speculatively at his subject.

"Damocles—what is the most delightful experience in the world?"

"It's not yodeling a few bars in the shower and finding out I sound like Donny Osborne," Dammy said with a smirk.

"Be candid, lad."

Dammy leered. "I guess it's when a nice-looking chick falls for you out of a clear sky."

"Precisely. Why?"

Dammy spread his hands. "You need a diagram?"

Xorialle shook his head dismissingly. "It's not merely the prospect of sexual contact, my boy; in most cases some such outlet already exists. It is, rather, the flattering insight into yourself; the surprising and reassuring news that you possess unsuspected charms capable of so powerfully affecting another."

"Nuts, Doc, there's some things you'll never get out of a test tube, and savvying the romance schtick is one of 'em—"

"No matter. We'll have ample time to turn up all your latent potencies later in the program. At the moment, we're concerned with basics. Come along." He rose.

"I don't know if I'm going along any farther with this training course of yours," Montgomerie growled, keeping his seat. "What's in it for me?"

Xorialle sighed. "Damocles, do you have any idea how much time and effort is wasted in acting out rituals designed to dramatize attitudes which in most cases are nonexistent—mere bows to convention?"

"Doc, give me a break, talk plainer," Dammy said sarcastically.

"You feel it's incumbent on you to pretend to a reluctance to cooperate with me; this in turn springs from the need to maintain the facade of an independent, self-determining, dominant male. So you propose to engage me in a symbolic conversation in which I slowly overcome your objections by acceptable means, such as cajolery, appeals to your curiosity and gratitude, and so on. And of course, you feel compelled to pretend skepticism of my statements in order not to appear gullible—just as a yokel, captivated by the chromium on a used car, will attempt to dissemble from the glib salesman his lust to buy,

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pretending indifference even as he signs the papers, lest he seem an easy mark; and as a woman will pretend to discourage the advances of a male she has already decided to accept, in order not to appear overly compliant."

"You sure cover a lot of ground, Doc," Dammy said in mock admiration. "From monkeys to card tricks to chicks that play hard-to-get. What's this got to do with me learning judo and how to live to be three thousand?"

"Learn to know yourself, lad," Xorialle said sadly. "Acknowledge that your charade of confident cynicism covers the fact that you're quite intrigued by the prospects before you."

"Try me!" Montgomerie barked. "Drop me back in Chi, and see how far I chase you begging for another chance."

"Yes—you're quite capable of turning your back on what lies before you, in order to maintain your role—like a stoic, proud of his reputation for abstinence, spurning the food he needs and desires."

"You're saying I *want* to be locked inside this ice-palace with a frustrated college professor, memorizing the spots on cards?" Montgomerie snorted. "Doc, if you only knew—"

"What sort of life did you lead outside, Damocles? A hand-to-mouth existence of . . ." Xorialle smiled sadly . . . "nursing a secret belief in your unique superiority, waiting for the wonderful surprise that will one day come along to transform your life."

"Me? I'm not waiting for anything—"

But Xorialle had gone on: "The surprise has arrived, Dammy. In a way, you *were* unique. You happened to be the one individual out of the billions whom I chose—at random, true—as my subject. Now let's proceed without further ritualistic objection." Xorialle turned and walked away. After a moment Montgomerie rose from the table and followed.

"This," Xorialle said, indicating a chair with a beehive-shaped apparatus hinged at the top, "is a synaptic catalyzer." He patted the device almost affectionately. "A rather crude field-model, assembled from local components as is everything here. But effective. It will make our task infinitely simpler, by speeding the normal learning process. Just take a seat, my boy, while I run a few calibration tests."

"It looks like a hair dryer in a beauty shop," Montgomerie said disapprovingly. "If anybody saw me sitting under that—"

"I thought we agreed to dispense with the rituals. It's understood you're fulfilling the role of a virile male, ready to fight for food or a mate, impatient of the effeminate. Sit down."

Dammy complied, with a show of reluctance. "You're going to flash slides on the wall, right, while I call off the answers—"

"I work directly with the cerebrum," Xorialle said absently,

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studying the dials on a small console behind which he had seated himself. "Initially, I'll fire a battery of impulses through your cortex, note the results, and adjust the input profile accordingly—"

"You're not scrambling *my* brains," Dammy said, rising quickly. Xorialle looked at him sadly.

"Dammy—scrambling your brain is, I assure you, the least of my intentions. I've gone to considerable trouble to procure a normal, healthy, untrained neural system to work with. The slightest tampering would destroy your usefulness to me."

"If running electricity through my head isn't tampering, I don't know what is!"

"That's correct: you don't. The catalyzer is analogous to the flashlight an oculist shines in your eye, testing, not destroying vision. Now kindly quell your superstitious fears and instinctive dreads and ritual objections and allow me to proceed."

Dammy muttered but made no further complaint as Xorialle lowered the dome over his head and returned to the console.

"Just sit quietly," he said. "The calibration will only take a few moments. It's quite painless, I assure you."

Dammy heard a soft buzz; voices seemed to clamor at the edge of hearing; but he felt nothing.

"You're not shooting X-rays through me?" he queried.

Xorialle gave an impatient grunt. "Neurotronic vibrations, identical with those produced by your own mentational field." He touched a key and the murmuring ceased. He twiddled knobs and levers, adjusted dials, frowning in concentration.

"Now," he said, "I think that our next order of business is to do something about that grotesque dialect you speak. Grammar and syntax have a function in communication that appears to have escaped you." He fussed over his console.

"I don't like the sound of that," Dammy protested. "You going to make me talk like a college professor or something?"

" 'Or something'," Xorialle mimicked. "A sterling example of the type of meaningless noise that clogs your speech. Quiet, now."

Dammy sat tensely; something tickled his brain; a soft squeaking as of gossiping mice chattered between his ears. It went on and on, while Dammy gazed down unguessed-of vistas suddenly revealed.

"Now," Xorialle's voice woke him from his reverie. "We should see a marked improvement. Say something, my boy."

"What do you wish me to say?" Dammy said promptly. "I mean, uh, sure, Doc. What about?"

"Don't fight the impulse to clear speech, Damocles. Tell me your impressions of the training so far."

"The techniques appear highly sophisticated; I'll be unable to judge their effectiveness until I've gathered more data—" Montgomerie broke off and shook his head. "For crying into

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your soft-boiled eggs, Doc, you've impressed on me a speech pattern which will attract ridicule from my peer group—I mean, damn it, I sound like a book! What was your intention—I mean what's the big idea—"

"There, there, calmly, my boy. Shall we proceed?"

"I have no option in the matter. I mean what does it matter what I think? You'll proceed in any event, I mean go ahead anyway!"

"Correct. Possibly you're learning a bit of wisdom after all, lad."

"Wisdom would have kept me clear of you in the first instance," Dammy said bitterly, "before you loused up my conversation."

"Tsk. Cynicism ill-becomes you."

Montgomerie spent five wearying hours under the catalyzer, while Xorialle clucked, muttered, poked buttons and issued cryptic instructions, lecturing the while. Afterward, they lunched on pheasant and wine, served automatically on what seemed to be an open-air terrace.

When they had finished, Xorialle handed a small book across to his pupil.

"Hoyle's Complete Games," Dammy read aloud. "I thought we had work to do. When will we have time for pinochle?"

"Don't be tedious, Damocles. You'll learn games along with the rest, of course."

"The rest of what, Doc?" Dammy frowned. "When do we get to jujitsu and —"

"Dammy," Xorialle cut in sharply, "In the next few weeks you will master the rules and techniques of every activity, skill, talent, sport, and art ever mastered by any human being, anywhere. Do I make myself clear? You will be as expert at chipping flints as at architectural drafting; as skilled at dominoes as at basket-weaving. Able to juggle, walk a tightrope, and add the numerals on the sides of passing freight cars as fast as any idiot savant in the land. Understood?"

"Now I know you're ribbing me, Doc—"

"My name is Xorialle! I am not a tribal shaman! I dislike the eke-name 'Doc'! I am not 'ribbing' you! And I'd appreciate it if you'd make use of your knowledge of your native language, before I forget my mission here and—"

"And what?" Dammy challenged as his mentor broke off abruptly.

Xorialle sighed. "Even your primitive tongue would be endurable if you used it correctly. You have complete knowledge of grammar, vocabulary, and syntax now—why not make use of it?"

"Habit, I guess," Dammy said indifferently. "Or maybe I just don't want to sound like a nance."

"I know a solution," Xorialle said grimly. "You'll learn Concensual Two: a simple form of speed talk."

"Hold it, Doc," Dammy demurred. "You said *human* skills, remember? I don't want any weird alien kind of stuff pumped into my brain."

"Nonsense. C-II is designed for

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interspecies communication, and is as free of specialized bias as the concept of language permits. It won't warp your personality any more than a knowledge of Navaho would."

"What's it sound like?"

Xorialle made a scraping noise with his tongue and hard palate.

"That was Lincoln's Gettysburg Address. I confess it loses something in translation." He busied himself at the controls.

"Relax, blank your mind," he ordered curtly. Dammy leaned back in the chair and closed his eyes. Abruptly a voiceless clamor started up somewhere behind his ears. It went on and on. He dozed . . .

". . . enumerate from unity to ten to the tenth," Xorialle was saying.

Dammy drew a deep breath and let it out. With an effort he suppressed his tongue's impulse to twitch, keeping his jaws clamped hard.

"What sszzrrchhh happenezzchhh?" he said.

Xorialle buzzed. A meaning seemed to want to attach to the sound, but Dammy shunted it aside.

"That made my head achesssdzzz," Dammy said. "Well, when do I zzsstart to speakrrrxx . . . ?" He paused. "My tongue feelzzz xxrfunny. Funny, I mean. My . . . tongue . . . feels . . . funny." He enunciated distinctly. "What did you do, Doc, louse up my talk box?"

"Xxxrrssszzzkk," Xorialle buzzed. "Bbyrrppp?"

"Say 'excuse me'," Dammy muttered.

"You don't understand me."

"You sound like a bluefly in a beer bottle."

"This is *very* strange; I was sure you had the capacity. Well, even negative data are data. A pity I don't have a master analyzer here; I'd like to get to the bottom of the anomaly. But it's outside my actual program in any case. Never mind. We'll continue in English—but do try to speak more precisely, there's a good lad. Now where were we?"

"You were talking about juggling . . ." Dammy reminded him.

"And human-fly work, steeplejacking, body surfing, skydiving," Xorialle paused for breath, "scuba diving, acrobatics, pole-vaulting, lariat-throwing, qualitative analysis, lens grinding, Wankel engine repair, tennis, skittles, curling, ballet—"

"Ballet!"

"Everything, Dammy."

"That's impossible," Dammy gulped, "even if I would go along with it."

Xorialle's expression tightened. "If?"

Dammy felt a sharp twinge in his chest. It was just a tiny glowing ember of pain, but it held steadily . . .

"If?" Xorialle repeated.

"All right, all right, what choice have I got?" Dammy gasped relief as the spark went out.

"As for the impossibility of the program, do you deny that somewhere, someone is expert in any given speciality?"

Dammy grunted assent.

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"What one man can do, another can do."

"But not all at once, for crying into your Alka-Seltzer!"

"Why not?"

"It takes a guy years just to learn to deal blackjack! And they say scientists spend twenty years in college these days, and then can't keep up with the new stuff coming up!"

"But you'll learn more quickly than they, Damocles. Open the book in your hand."

Montgomerie flipped the pages, stopped at one headed: EUCRE LAWS.

"Key words," Xorialle snapped.

Dammy started to comply, but the oldster cut him off:

"Subvocalize!"

Dammy thought: *three of spades . . . prize.*

"Look at the page." The words hung in the air like solid objects.

Dammy glanced at the close print.

"Riffle the pages."

Dammy complied, glancing at the blur of swiftly turning leaves.

"Close the book."

He closed the book.

"Recite."

Dammy opened his mouth to object—

" '21. If any player names the suit already turned down, he loses his right to name a suit; and if he corrects himself and names another, neither he nor his partner is allowed to make that suit the trump.' "

"You now know," Xorialle said severely, "the rules of eucre. It remains to absorb the strategies of actual play."

"OK, so I memorized a couple lines," Dammy said. "What about the other four hundred pages?"

"You know them," Xorialle said complacently.

"So what will that make me—a card sharp? I've got bigger ideas than that, Doc."

"You won't stop there. You'll absorb all the information in all the books—your race's entire heritage of knowledge."

Dammy snorted. "Even flipping pages like riffling a deck, I couldn't get through all the books there are in a lifetime."

"Oh, you'll use the tapes, of course. The viewer will project them at high speed, as soon as we've coaxed your scanning rate up to a reasonable figure. You'll be able to absorb the Britannica, for example, in about eighty seconds."

"Look, I'm no supergenius, Doc; my brains won't hold it all."

"How many days has August?"

"Ah, thirty days hath September," Dammy murmured. "April, June, November . . . thirty-one," he announced.

"You see? The datum was there, but encoded. We will encode a great deal more information."

"If I stop and recite a poem every time I want to remember something, they'll lock me up in the chuckleward," Dammy objected.

"Our codes will be simpler and our retrieval much faster," Xorialle reas-

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sured him. "Now, off to bed with you, lad. Tomorrow we'll be taking up the physical portion of the program, and I want you fresh and full of vigor."

"Yeah," Dammy said, yawning. "Good idea."

In bed, Dammy stretched luxuriously, then scratched at a small but persistent itch behind his right ear. The spot was tender, slightly swollen. He fingered it, trying to recall . . . Three of spades.

. . . *a fading pain in his abdomen, the pull of new stitches there—and the ghostly sensation of the scalpel against the mastoid process, the remote vibration of the bone-drill, then Xorialle's deft fingers slipping the control device into place to extrude its semiliving organo-metallic filament which followed the auditory nerve to the cortex, whence it elaborated into a network invading every portion of his cerebrum. Curiously, he examined the structure, using hitherto unused senses and organs of introspection to trace leads, analyze circuits, and study receptors. So doing, he glimpsed the fantastic complexity not only of the invading filamentary network, but of his own mind. Phantom perceptors and manipulators lay unused in his brain. The alien network ended, but Dammy went on* . . . Gradually, probing gingerly along newly-discovered pathways, he began to grasp the dynamic symmetry of the fantastic structure that was his mind. Then he blinked and turned his thoughts to more mundane matters. *So the old devil was lying about that, too, when he pretended to be using pure mental control to stab my gizzard and freeze me stiff,* he ruminated. *I wonder what he's really up to . . . ?* He rose, got his tool kit from the closet, then went to the door, squatted, and studied the tiny aperture beneath the latch. He selected a wire-thin instrument from his kit, inserted it, put his ear to the door and slowly rotated the pick. There were faint clicks from the mechanism. Something *snick!ed* with a more decisive sound. Dammy withdrew the tool and tried the latch. The door opened smoothly. He stepped out into the passage, went quickly to the stairs, descended to the library level. The lights were low in the Book Room. He went to the section devoted to Xorialle's off-world texts, selected half a dozen of the small cubes, dropped them into the feed tray of the scanner and switched it on. The screen lit up. For an instant the pattern of close-packed dots seemed meaningless; then abruptly information was leaping at him from the page.

Three of spades, he subvocalized, and settled himself in the chair, his eyes on the screen . . . *Prize.*

He blinked and sat up. His neck ached, his eyes burned. A glance at the clock showed that six hours had passed. The screen before him was blank. He switched it off, replaced the data-cubes and returned to his room, strange thoughts buzzing in his mind. He slept quickly, but had troubled dreams.

TO BE CONTINUED

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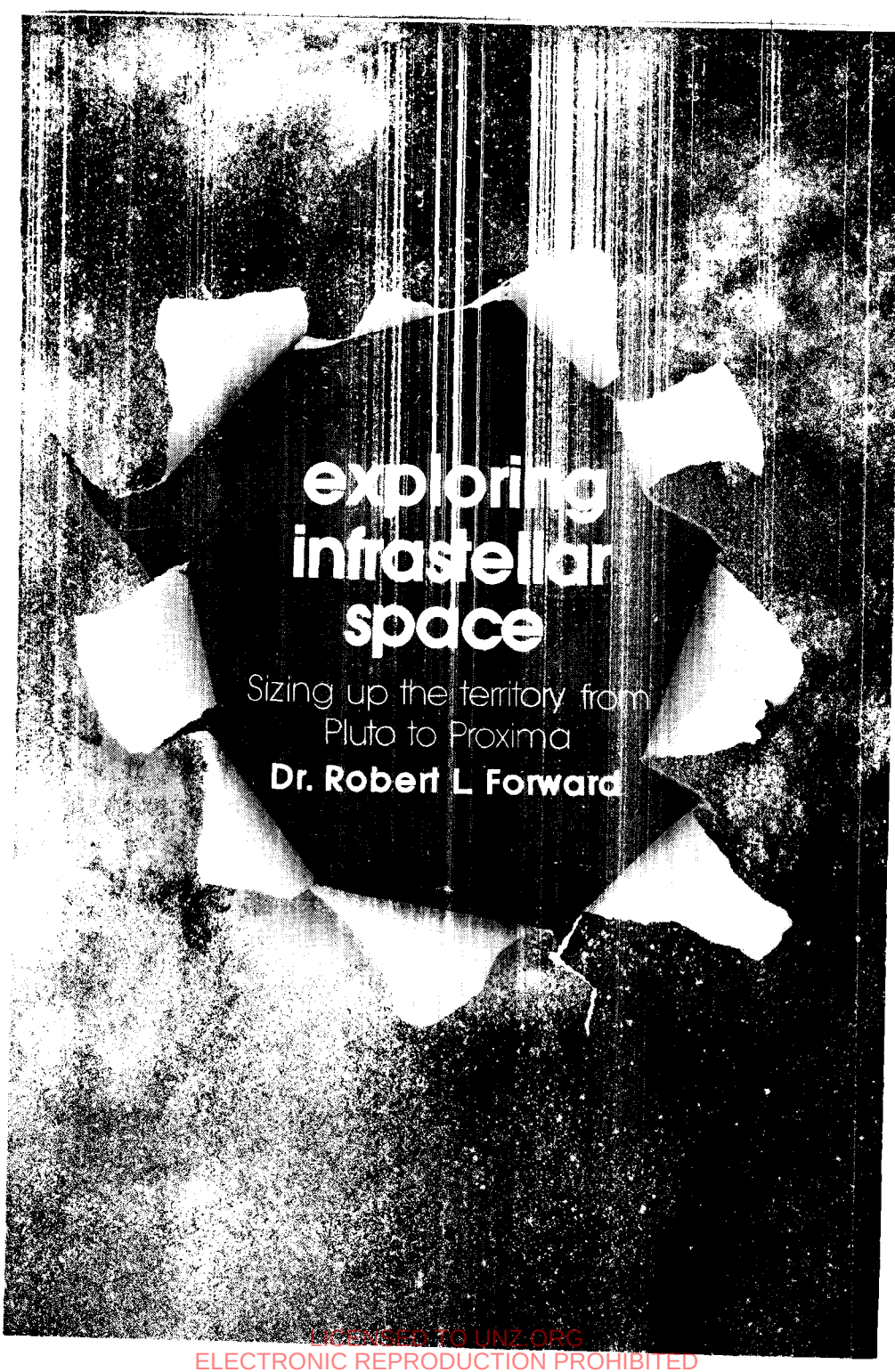

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Is there any reason for us to now consider the conduct or design of space missions beyond the solar system? If so, how should we get started?

We could talk about lots of different possible missions: Interstellar Flight, Gravitational and Relativity Experiments, SETI (Search for Extraterrestrial Intelligence), as well as many types of observational programs: Cosmological, Galactic, Near-Stellar, Infrastellar, Extrasolar, even Introsolar—going out and looking back at ourselves, snuggled up to the warming Sun (Don't forget, we developed a whole new perspective of the Earth when we went way out to the Moon and then looked back at our big, blue, floating, fragile marble). You might expect that I would have a tendency to concentrate on interstellar flight, but even I have to admit that to get to the stars, we have to cross an awful lot of wild, and black—but interesting—territory before we get there, and we might be missing something important if we didn't do a little bit of exploring on the way. So let us speculate and think—and plan—as we go about sizing up the territory from Pluto to Proxima.

If we start with a circle of 5 AU encompassing Jupiter's orbit (the part of the solar system we have only just begun to explore), and expand it an order of magnitude to 50 AU, or about 1/1000 of a light-year, we take in the entire known solar system. (How parochial that sounds!) If we expand that by an order of magnitude to 500 AU, or about 1/100 ly, we take in a few short period comets (attendants of Jupiter). If we expand that by another order of magnitude to 1/10 ly, or 5000 AU, we find—*nothing new!* If we expand that by *another* order of magnitude to 1 ly we still find *nothing!* (or at least we know of nothing out there). Only after we have expanded our circle of interest out to 10 ly do the nearest stars draw into our picture. There sure seems to be an awful lot of nothing out there (or at most a few fluff-ball comets).

Things to Do and See
On Your Way to Proxima Centauri

Just as the ancient cartographers populated the blank corners of their maps with strange beasties and dragons, so also can we (although we do it in a properly scientific and sophisticated way). Is the deep space between Pluto and Proxima empty? or is it filled with strange wonders? We know there are comets out there, we can calculate their orbits and know that they come from a comet belt out at about a light-year. *But*—there is a gap in the comet aphelion distances between 1000 and 5000 AU. What strange monster lurks out there to hurl the comets down to a scalding death around the Sun if they dare to cross its path?

Some astronomers say that there must be every size of planetoid from gram-sized pebbles to protostars sprinkled uniformly from here to there. The Sun and planets have swept up everything here, but how many are

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still out there? Long ago, Shapely pointed out that the process of gravitational contraction of dust and gas would form objects of all sizes, from larger than the Sun to smaller than the Moon. However, only those centers of condensation with a mass greater than about 1/10 of a solar mass would actually ignite to form a visible star. Those between 1/10 and 1/1000 of a solar mass (bigger than Jupiter, but smaller than the Sun) would not have nuclear fusion taking place in their interiors. However, they would still be heated internally by radioactive decay and gravitational contraction. Shapely called them crusted stars or self-warming planets, and postulated that life might even exist on them. He estimated that there should be ten of these Lilliputian stars for every visible star, and that one could exist at a few thousand AU, with its IR radiation undetectable by our best sensors.

Roach recently expanded on these speculations and attempted to make a quantitative estimate of the interstellar density of these Lilliputian stars. He constructed a log-log plot of the cumulative number density of objects versus their mass. At one end were the stars, and at the other end the galactic dust. An interpolated curve was used to estimate the space density of the objects of planetary mass. From this, Roach estimates that within a sphere halfway to Proxima there could be 10 objects the mass of Jupiter, 1000 of Earth size, 60,000 of Moon size, 5 million asteroids and a trillion large comets. The existence of these large numbers of large bodies cannot be yet ruled out by orbital predictions. The present state of knowledge of the observed motions of the outer planets does not even rule out a crusted star of 1/100 of a solar mass as close as 700 AU.

There seem to be a lot of things out there to look at. Let's go out there and see.

"See!" you say. "With what? There is no light out there."

I say, "Try IR for the hot ones, radio for the belted ones, radar for the reflective ones, flux meters for the magnetic ones, lightning flash detectors for the stormy ones, gravity for the massive ones, and stellar occultation for the bulky ones. But one of the things we should do is invent and develop other sensors besides these obvious ones."

"Aren't *bulky* and *massive* synonymous?" you say. No!—not if you believe in Hawking black holes, which are hot and massive, but so small they couldn't occult a microbe. Hawking holes are a new astronomical concept. They are primordial black holes with asteroidal masses but Angstrom dimensions emitting photons and particles which tunnel across their classically impenetrable gravity potential well. The smaller the mass, the hotter the effective temperature, and the faster the mass dissipates until it finally disappears in a burst of radiation. Those less massive than Phobos are already gone, but those larger have a long life yet, and are out there glow-

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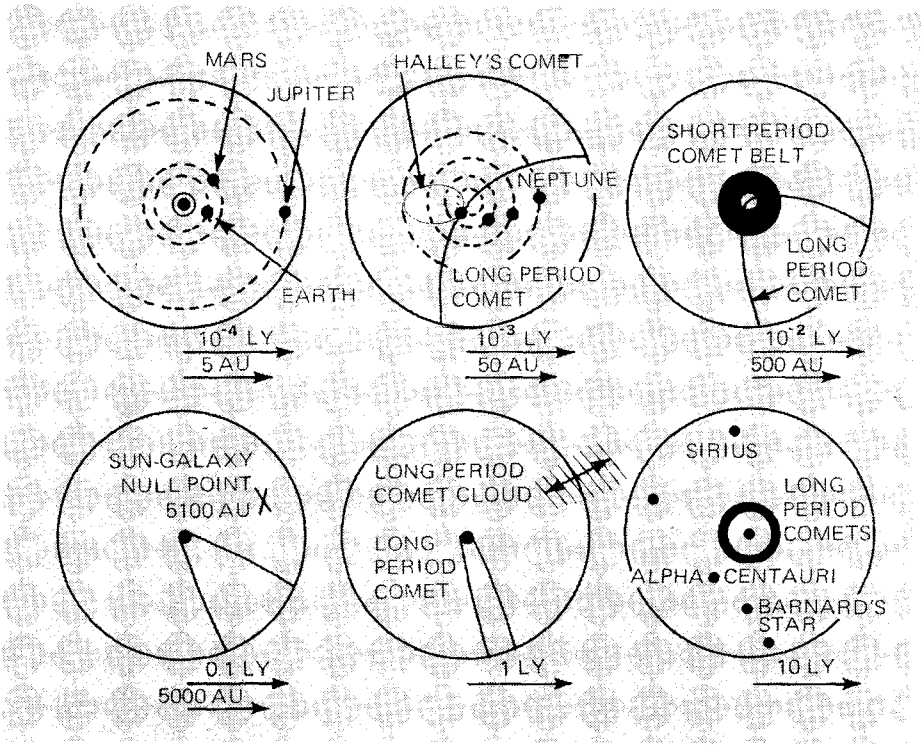

Figure 1: The scale of deep space (adapted from Hennes, et al)

ing—an incandescent speck a few Angstroms across.

There might be other things to look for out there besides the obvious particles and fields, the dark planetoids and the black holes. In and on the dust and planetoids there may be organic material or even viable spores. If we could find a technique for looking for this organic material we could test the interstellar panspermia theory. How do we "filter" out the organic from the inorganic. With a physical "filter"?—or can we come up with a radiative equivalent by using selected laser wavelengths which excite a fluorescent response whenever the beam strikes the right organic molecular bond? More ideas are needed.

See the Stars on Only a Million A Day

Off we go on a mission into deep space! We have a long way to go and we don't have all century to do it in. It isn't going to be easy, and it isn't going to be cheap. Fortunately, the cost can be spread out over decades,

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so the mission cost will come down to merely a million a day (in constantly inflating dollars). But still, a lot of thinking now will pay off in significantly lower costs later.

First, we have to start thinking about how we are going to get out there into deep space, and do it in a reasonable time. To do this will require propulsion concepts that are significantly better than the chemical rockets starting from the surface of the Earth that we use now. There are a lot of ideas around, so let us look at some of them, and try to dream up better ones.

Long ago, Krafft Ehricke took a hard look at what you could do using the gravity whip concept to get out into deep space. It is obvious that by going out to Jupiter and using it to slingshot in toward the Sun, you could arrange a very close, very short, highly elliptical pass around the Sun. If you applied your thrust at perihelion, you could obtain significant gain factors in your ultimate escape velocity. He also found a maneuver that improved things more, a tricky Saturn-Jupiter-Sol double cushion shot. However, even with all these tricks, you still need a lot of delta V, and it has to be applied in the short period (1 to 10 days) when you are closest to the Sun. This requires many days of high thrust acceleration at 1/10 g and rapidly gets us away from present propulsion technology. You also only get significant gain factors when the perihelion is very close to the Sun, like 1/100 AU. At 1/100 AU, the 6000-degree solar disk is covering one-third of the sky, and you roast unless you have brought a comet along to hide behind.

So, since present propulsion concepts and gravity whips don't seem to do the job, what can we consider?—and which ones shall we work on in the future?

We could consider the Orion, or pulsed nuclear rocket concept. There are many versions of this, from the technologically feasible one-atomic-bomb-per-second monster to the near future laser or electron beam ignited micropellet fusion concepts that buzz along at 250 miniature explosions a second.

There are various versions of the controlled fusion rocket, including the Bussard interstellar fusion rocket ramscoop concept. However, any design of these has to wait until we find out how heavy a magnet is needed to obtain controlled fusion here on Earth.

Perhaps we should think about non-fusion versions of the ramscoop. Could we obtain better performance out of a hot hydrogen nuclear or electric-MHD rocket if we scooped up our hydrogen supply as we went along? How do you build a scoop that preferentially gathers hydrogen without a weight penalty that negates the advantage? Can you use radiation or lasers to presweep the dust and helium and gather in the hydrogen? Do the lasers have to be on the vehicle or can that job be done from Earth or an orbiting station?

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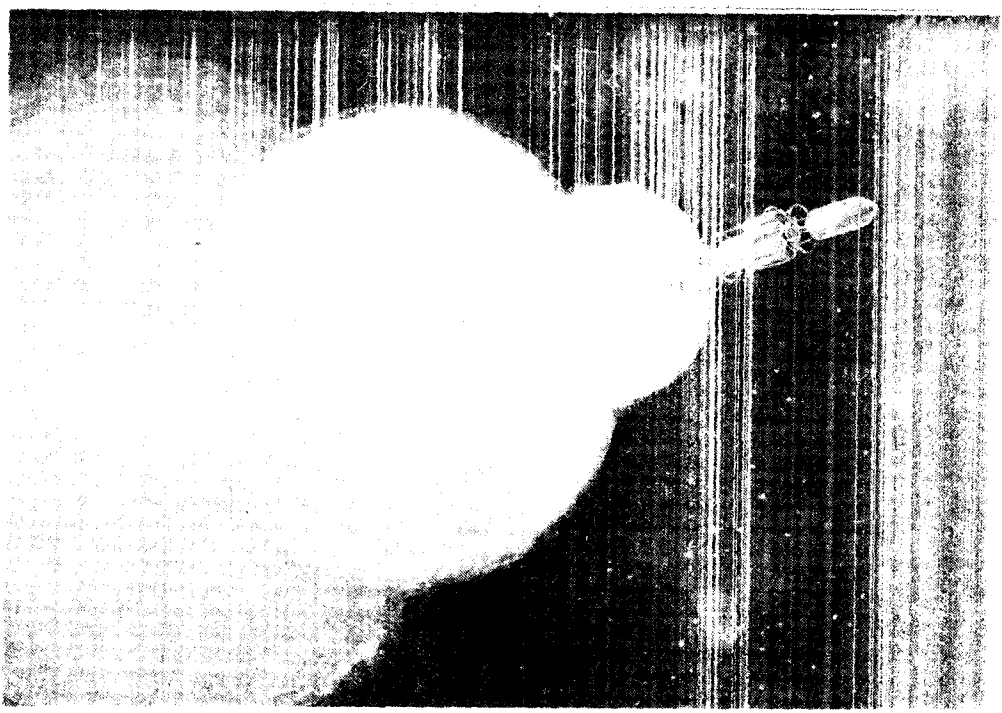

Figure 2: Nuclear pulse jet rocket (Orion concept)

How about sailing through space using a solar sail? At first, this looks like a poor idea for propulsion in deep space where the Sun is just a bright star. But if you combine it with the gravity whip concept and carry out your propulsion phase near the Sun, it begins to look much more promising.

Although we call it solar sailing, the present state of the art of solar sailing is far from the sophistication of the Clipper ships and Hobie cats of wind sailing. Wind-sailing ships can tack into the wind, because they have keels. Solar sailing is still in the dark ages—like using a blanket on a raft. Can we give the solar sail a keel?

The wind-sailing ship moves through the slippery water in one direction, the keel applies pressure to the water at right angles to that motion, while the sail feels the pressure from the wind at some other angle. When the resultant forces are added up, the wind sail can tack into the wind.

To give the solar sail a keel, we might try using the solar light as our water and the solar wind as our wind (or vice versa). A charged mesh would pass the light, but reflect the ionized solar wind. We also might try using the trapped magnetic field in the solar wind as our water and the light as our wind. To grab onto the magnetic field we can use the Lorentz force. By charging portions of the solar sail to high voltages (adding long wires will increase the self-capacitance and therefore the total charge) we can use

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the Lorentz force F=q(vXB), which is at right angles to the direction of the solar sail velocity and the magnetic field. I don't know whether the Lorentz keel will work for solar sail missions near the Sun, but it is an interesting concept that needs to be first checked analytically, and then checked again by tests in the real space environment.

There are other versions of the solar sail. One is to use a laser instead of sunlight. This could be used in addition to the solar thrust, or for prime propulsion, or for trajectory trim on the way out into deep space.

If it turns out that the solar sail could provide us with the propulsion that we need for a deep space mission, how do we get started? Tests of solar sail material on the upcoming LDEF, Long Duration Exposure Facility, are obvious first candidates. [The LDEF is a large cylindrical framework that will be left in space by one of the first shuttle flights and picked up eighteen months later. Trays with experiments to check on the effects of the space exposure on various materials are bolted to the main frame which supplies power, cooling, data collection, and other housekeeping functions.] What are the best sail materials? Metals and strong nontearing coated films are obvious. How about completely new concepts such as a bimolecular film like a soap bubble, only with viscous glass instead of soapy water to provide the extremely thin, but self-repairing feature of a soap film? More and better ideas are needed.

After we get the propulsion to get out there, what are the other things we can do besides measure particles and fields? (I include in particles everything from an electron to a crusted star.) Some possible ideas are:

- Develop a very long base line radio interferometric capability by sending probes to different parts of the solar system. Think what a field year the radio astronomers would have with a 1000 AU base line!
- Establish a network of deep space laser communication relays to increase the data rate back from

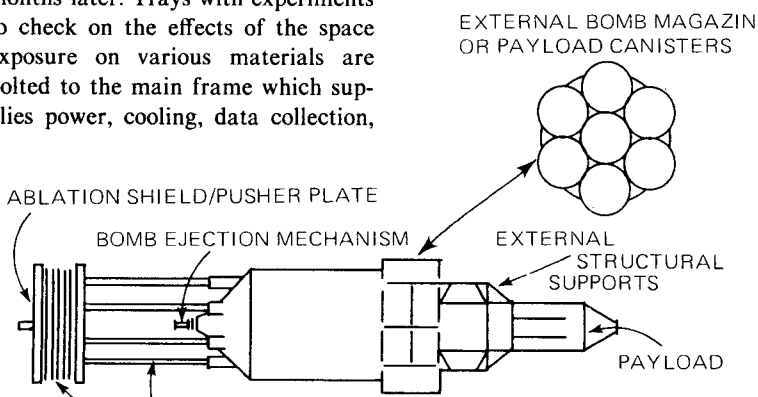

Figure 2a: Nuclear pulse vehicle

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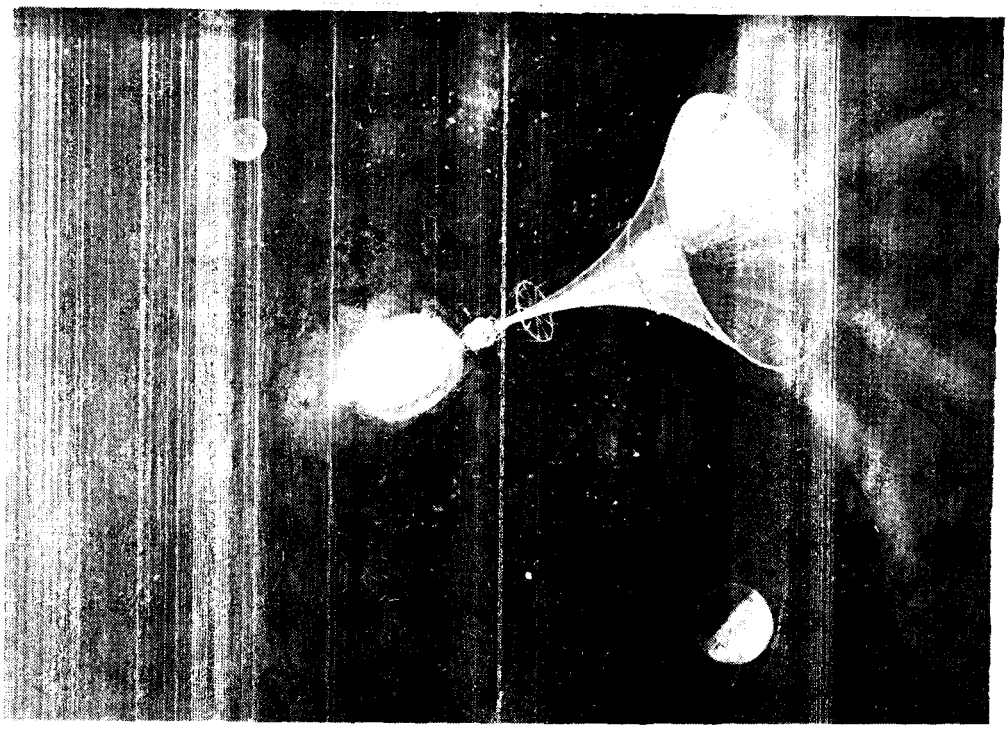

Figure 3: Bussard interstellar ramjet

smaller probes sent out into the deeper reaches of space.

• Carry out tests of the prototype probe designs for an interstellar mission. Send the probe out to 1/10 ly, then have it come into the solar system and see if it is smart enough to find life in the solar system. If the probe is only semi-intelligent we won't tell it the answer ahead of time. If it is really intelligent, we can tell it ahead of time, and it can pretend it doesn't know while it is going through the search procedure. (We could probably trust it not to peek at that part of its mind better than we could any human raised with our wily animal heritage.)

Probe Design for Infrastellar Exploration

In the days before the ubiquitous telegraph and newfangled telephone, the launching of a student off to a distant college to learn about the mysteries of the world was as fraught with uncertainty as a launch of a probe into deep space. You had to hope that your years of training had developed not only a routine habit pattern that would keep the traveler on course and functioning, but had also developed a strong capability of independent thought so that the traveler could cope with the uncertainties and problems that would have to be faced many miles and many days away.

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In the same way, we are going to have to develop probes that can not only be programmed ahead of time with instructions and contingency plans, but also that are "intelligent" enough to function properly under circumstances or opportunities that we could not foresee and program before the mission started. The first robot probe to visit another planet was the JPL/Hughes Surveyor. The two-second time delay from Earth to Moon required minimal preprogramming and intelligence. We are already well into the multicontingency preprogrammed probe with the Viking orbiter and lander, but it is already obvious that we could use some more intelligence at the other end of our half-hour-long communication link with Mars. If it were really intelligent, the Viking lander should have known by itself that the locking pin on the arm was stuck and jiggled the arm a little until it fell out. Things will be even worse for a deep space probe, where time delays will be measured in days and months rather than minutes. Is there a way out?

First, we can hope that ongoing research will develop better and better concepts for intelligent computers and that these can be incorporated into the probe design. This would be the best

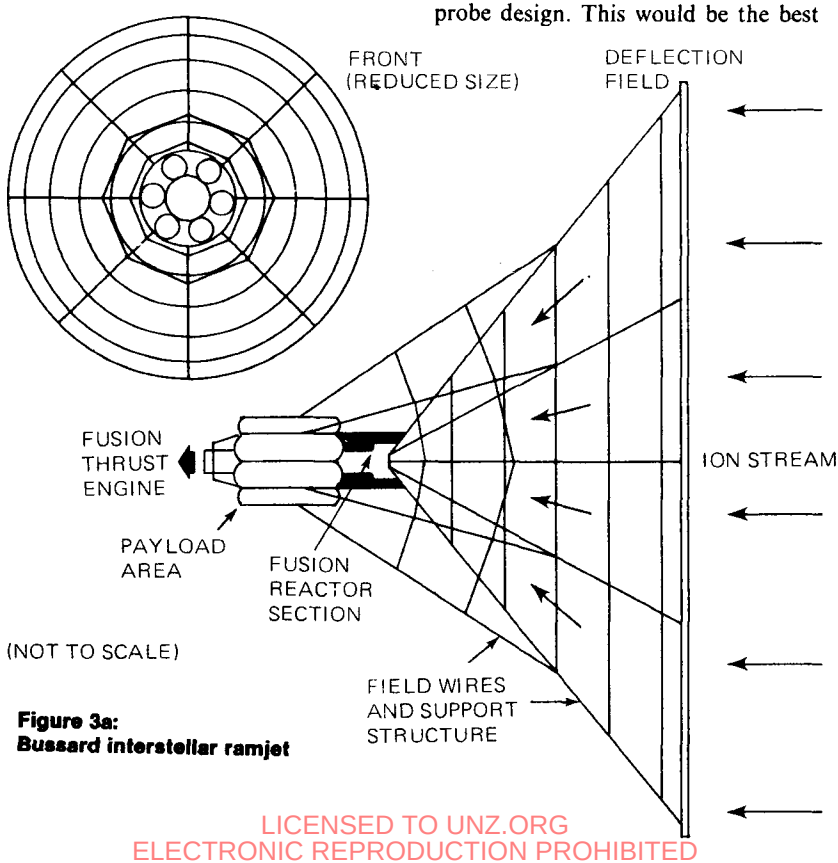

Figure 3a:
Bussard interstellar ramjet

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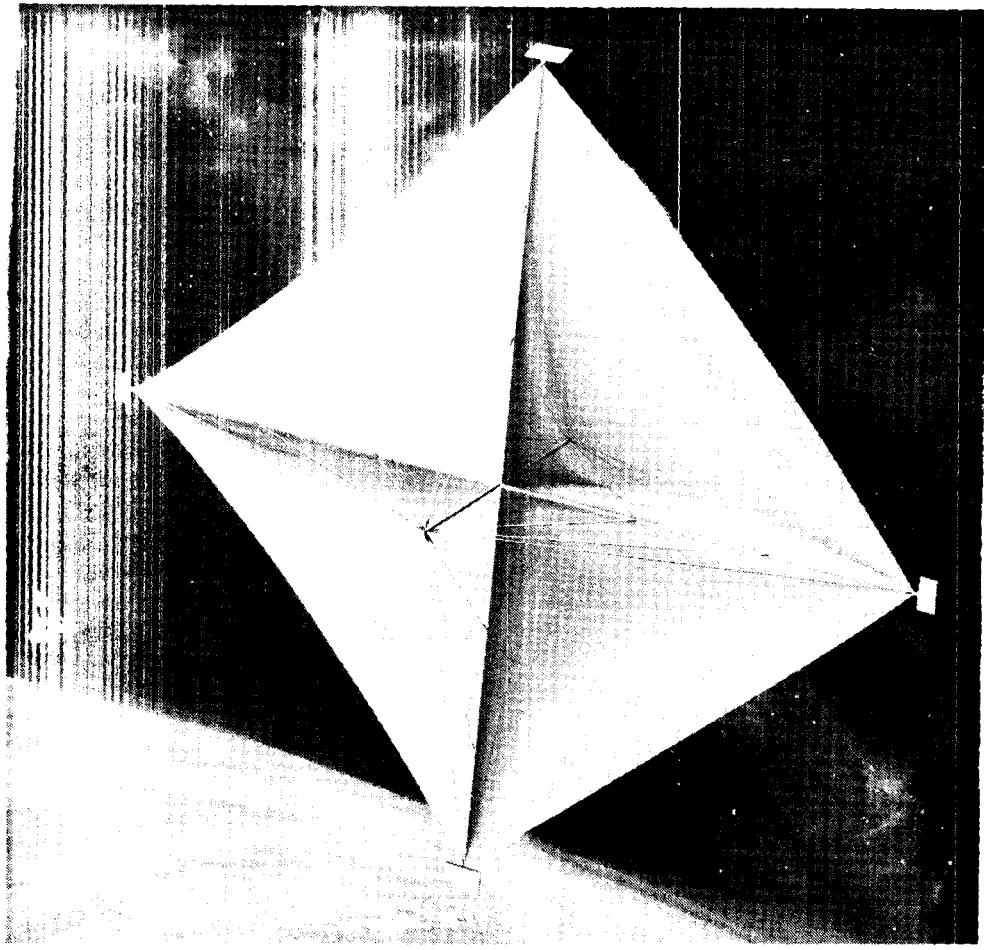

Figure 4: 0.8 kilometer square solar sail

solution, and is one of the near term efforts that we should concentrate on. However, despite my usual extreme optimism, I don't see any significant breakthroughs in this area; just a constant, tedious, slogging, slow improvement in the average electronic IQ of computers, and I wonder whether that electronic IQ will be sufficient for the job of managing a probe by the time we want to launch it. There is no question that we ought to work in this area, and work hard, but it is also reasonable to consider alternatives.

One way of getting some intelligence in the probe is to use the present, well-developed intelligent ionic computers instead of waiting for the development of the newer electronic versions. Yes, I know they are bulky, slow, wasteful of power, unreliable, and have a rather low operational and survivability environmental range; but they *are* available, and *definitely* have

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the kind of intelligence that we would supply if we were there ourselves.

Yes, you guessed it—what is really *wrong* with a *one-way* manned deep space probe? Is it really out of the question? Or should we seriously consider it in a really broad search for the optimum deep space probe? "But a one-way mission!" you exclaim. "Even if you could get a volunteer, the public wouldn't allow it!"

Yet—each one of us—right now—is one a one-way mission through this life. We come into life without a choice, we train for a career, and if we are lucky, we find an exciting career that we can stay in and contribute to for the rest of our working lives. Then, if it is a career like writing, law, politics, or science, which don't have an arbitrary retirement age, and which don't depend primarily on the strength of your body or the freshness of your education, we find people working at their careers with gusto until they finally die in the harness. The missions that we can plan in the deep space from Pluto to Proxima are going to take decades. They are open-ended missions, in that there is always something interesting left to do. In fact, these missions are well matched to the productive lifetime of a well-trained individual just starting off in a lifetime career after completing graduate education. What an exciting career! What an opportunity for immortality in the annals of science! Then, at the end, a tomb that would exceed that of King Tut's in splendor and agelessness! No, in my opinion, a one-way manned deep space probe is *not* out of the question.

Another possibility is to not have intelligence at the other end of the communication link, but instead use a system similar to that employed by the blind driver ants in the jungles.

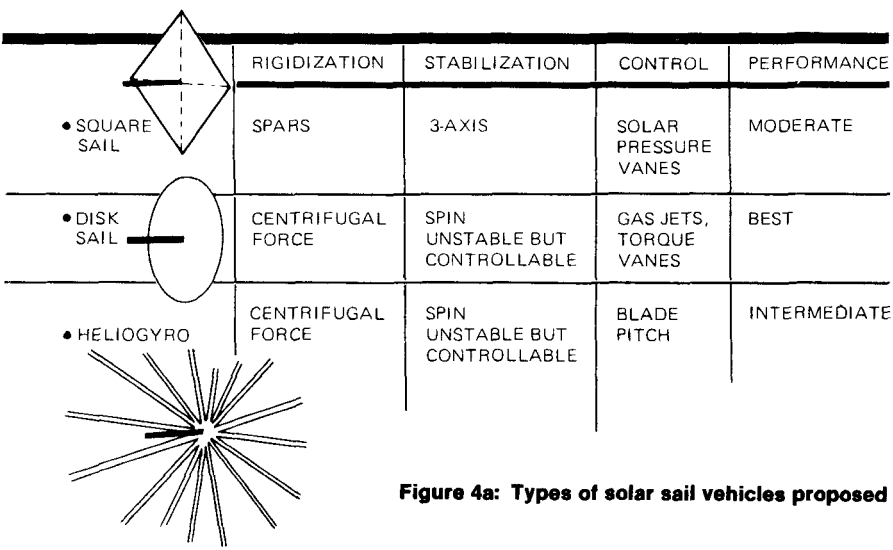

Figure 4a: Types of solar sail vehicles proposed

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Instead of sending out a single large intelligent probe to find and bring down a giant planet out past Pluto, send out a swarm of small, preprogrammed probes. We would lose many due to trivial causes, but one or more of them is bound to stumble blindly into the target.

There are two versions of this approach. First, we could make the probes so simple and small that many would stumble on the target, each to sample only one of the many possible characteristics. (One responding only to acceleration, another to magnetic field, another to temperature, etc.) Alternatively, the swarm could be more sophisticated, and smaller in number, with scouts out front which find a target, then send signals back to the main swarm to gather those behind it that have enough delta V to swerve toward the target ahead.

These kind of thoughts lead us to another area of thought suitable for brainstorming. How small can we make a probe? Of course, that depends upon what we are asking it to do, but suppose we only ask it to do one simple thing? How small can we make it and still get the information back from it? Can it be as small as a kilogram?—a gram?—how about a milligram?

Let me try to give an example of what might be a minimal probe. The basic structure would be a thin fiber or a fiber mesh with imbedded metallic films, wires, microcircuits and spots of radioactive isotopes. The charged particles shooting off into space from the radioisotope would leave a charge on the probe, which would leak off into space at field emission points. By proper placement of the charging radioisotopes and the discharging field emission points, currents can be made to flow in the metal coated portions of the probe and used to power the microcircuits which collect and process the data and convert it to rf signals. The rf energy is then radiated into space by the probe acting as a multielement array of electromagnetic dipoles. By tracking the probe swarm as it moves in helical paths through space, the strength and direction of the magnetic field, and possibly even the ion and particle density can be calculated. Will there be enough rf generated to get back to a relay? I don't know. Our receivers will be better then, the directionality of the beams from a multielement array will aid in antenna gain, but lose in contact time (do we really need to have constant contact with all members of a swarm?), and the bit rate to be transmitted is low.

These milligram, unintelligent probes are one extreme, a multiton, one-way manned probe is another, the typical one ton JPL deep space spacecraft such as the Mariner Jupiter-Uranus (MJU) spacecraft is what people usually settle on for their studies. I bring up these extremes to stretch our imagination for it may be that for deep space exploration, the optimum probe is not a stretched version of the Mariner Jupiter-Uranus spacecraft.

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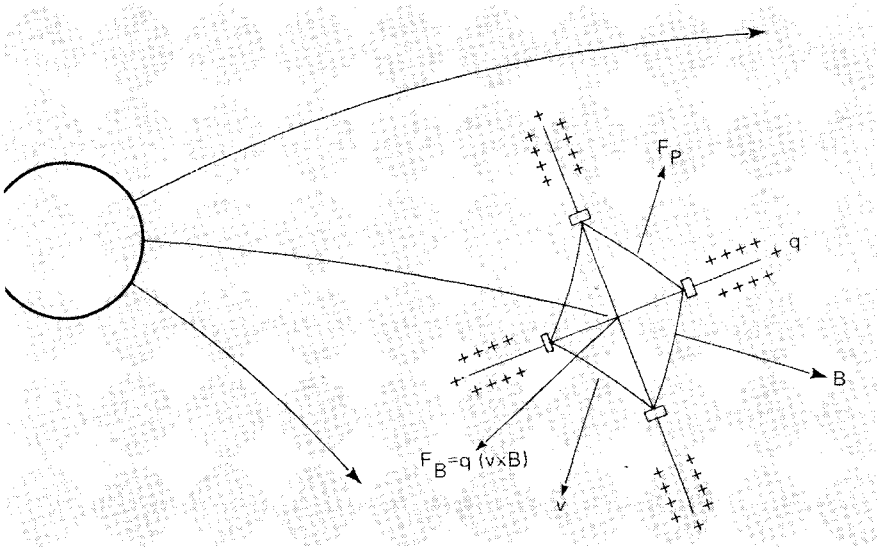

Figure 5: Charged square solar sail experiencing solar light pressure force F_p and solar magnetic field Lorentz force $F_B = q\ (v \times B)$

Conclusions and Recommendations

The SETI program is getting started in a significant way in NASA because the people working on the program found a good starting point that:

- Was more than another study
- Furthered the long range goals of SETI
- Could be started with near term technology
- Had good technological fallout potential
- Didn't cost too much.

The people on the SETI program are designing and building a broadband, multichannel spectrum analyzer to attach to Arecibo to look for SETI signals (and just incidentally improving the performance of Arecibo by 40 dB). What candidates do we have?

- Electronic intelligence research—*but*, based on developing a limited intelligence to solve the limited set of problems that will be faced in deep space exploration.
- Design and space environmental test of solar sail materials on the Long Duration Exposure Facility (LDEF).
- Engineering studies of the equipment and search strategy for the detection of planetoids and crusted stars in deep space.
- Design and test of spacecraft charging techniques and the efficacy of the magnetic keel concept, both in

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near Earth and near solar space.

These are just a few suggestions to help us get started; I am sure we will have many more. I fervently hope so; for I sure would like to be around to help push the launch button when the first probe sets off into deep space to blaze the trail to the stars.

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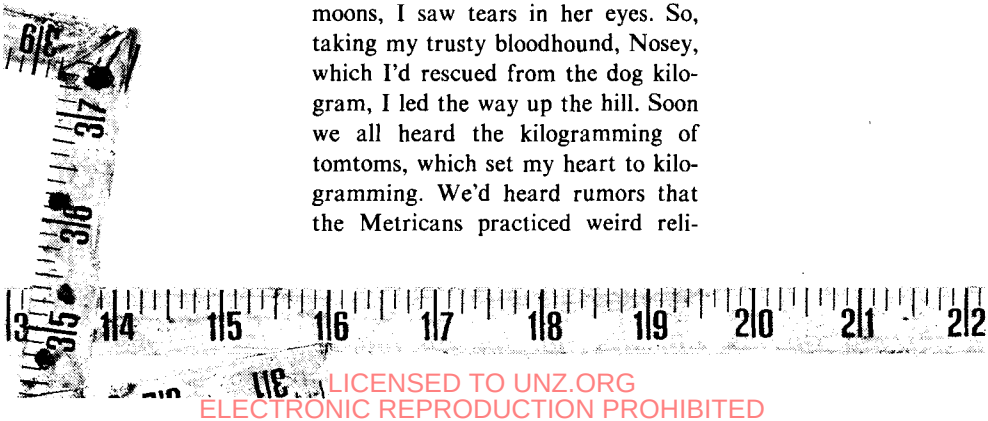
have you been converted?

We were millimetering along the one-third-meterpath, following in the one-third-metersteps of the alien kidnappers of Metrica, who had stolen little Ezra Kilogram, budding poet, from his fenced in frontmeter alongside our spaceship, *Kilometers Standish*. We had tried diplomacy on this First Contact with alien sentients; but as Commander Gernsbach said, "You give the dirty fiends a centimeter, and they take a kilometer!" There are plenty of one-third-meterprints to follow, and we were able to see the three-pronged tracks by the light of the seven moons of Metrica.

There were three of us bgramming along the ever ascending, rocky path: little Ezra's mother, Captain Penny Kilogram; Lieutenant Hammer, whose very presence usually gave me a kilogramming headache; and I, Sergeant Seek. At the one-third-meter of the hill, the officers said, "Sergeant Seek, you lead the way so that, if we find the enemy, you can pgram on them and trgram them while we carry little Ezra Kilogram, that half-liter-sized darling child, back to the safety of *Kilometers Standish*."

"Give them no literer!" cried pretty Penny Kilogram.

By the light of the first literer moons, I saw tears in her eyes. So, taking my trusty bloodhound, Nosey, which I'd rescued from the dog kilogram, I led the way up the hill. Soon we all heard the kilogramming of tomtoms, which set my heart to kilogramming. We'd heard rumors that the Metricans practiced weird reli-



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gious rites involving blood sacrifice, so little Ezra Kilogram's life was in danger. Alcohol coursed through my veins, as I had been imbibing steadily since the double sun of Metrica was over the meterarm, making me one-third-meterloose and fancy free.

"Onward, Nosey!" I shouted. "No matter that we are weary and 30.48-centimetersore. We must rescue that sweet baby before his blood is spilled, and not let a little child be used as a political one-third-meterball."

At one point we were set upon by one-third-meterpads, but Nosey frightened them away with his fierce snarl. He would have chased after the robbers, but I put my one-third-meter down.

"No, Nosey, we must rescue little Ezra Kilogram before the aliens kilogram him to death!" I insisted.

"Onward!" cried pretty Capt. Penny Kilogram, "for we cannot get a one-third-meterhold on this planet if we allow the aliens to kidnap our gallant numbers."

Now the kilogramming of tomtoms was so loud I couldn't hear the kilogramming of my heart. We burst into a clearing and saw an alien three meters tall using poor little Ezra as a one-third-meter-stool. The alien wore nothing but a forty-liter hat plus cowboy boots with spurs on his one-third-meters.

Pretty Capt. Penny Kilogram flgrammed up to the alien and cried, "Un-one-third-meter my child, you fiend, or you'll find you have one one-third-meter in the grave! Sergeant Seek, trfram this foul fiend!" Then she clapped a hand on her rounded bottom and gasped, "He pcentimetered me!"

I advanced cautiously, putting one one-third-meter in front of the other. When I stood in front of the alien, he made a literer turn to face me and demanded in a loud, harsh voice, "Have you been converted?"

As usual, when confronted by authority, I put my big one-third-meter in my mouth and muttered, "Take your one-third-meter off that kid or I'll kilogram you to little bitty pieces, you sonuvabitch!"

To which the alien replied, "Skilometer when you say that, podner!" ■

IN TIMES TO COME

Mack Reynolds is back, after much too long an absence, to lead our next issue. His new novel, "Of Future Fears," starts like a thriller: a band of terrorists hijack a miniaturized thermonuclear weapon, and Rex Bader—the world's last private investigator—is called upon to find the weapon before it is used to destroy an American city. But, like most of Reynold's tales, there's a lot more going on here than a simple cops-and-robbers chase. Vincent Di Fate has done another of his fine "orbital hardware" paintings for the cover.

The October issue will also include a deep look at laser weaponry, and the military and political implications that spring from making "death rays" a reality. Plus more stories and features.

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the last battalion

The development of science requires open minds and international communications. Oh yeah?

David Drake

MICHAEL GILBERT

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"Well, I'm sorry it stopped working," Senator Stone answered irritably over his shoulder, "but since the late news was one of the things I got a mountain cabin to avoid . . ."

"Well, it is strange," his wife repeated. She was as trim-bodied at fifty as she had been when he married her just after VJ Day, the first time he could think of a future after three years of flying Mustangs into hostile skies. She was still as stubborn as the WAAF he had married, too. "It was fine and then the color went off in flashes and everything got blurry. And it's getting worse, Hershal."

Stone sighed, closing a file that was long, confidential, and involved the potential expenditure of $73,000,000. The cabin's oak flooring had an unexpected tingle as he walked across it in slippers to the small TV. His feet were asleep, he thought; but could they both be? Not that it mattered. He slapped the set while Miriam waited expectantly. The screen continued to match colored pulses to the bursts of raw noise coming from the speaker. Occasionally an intelligible word or a glimpse of Dan Rather slipped through. "Some kind of interference," Stone said. He was six feet tall, with a plumpness that his well-cut suits concealed from the public but was evident in pajamas. His hair had grayed early, but it was still thick and smooth after sixty-one years, no small political asset. Stone was no charmer, but he had learned years before that a man who is honest and has the physical presence to be called forthright will be respected even if he is wrong—and there are never many candidates the voters can respect. Shrugging, he clicked the set off. "If you needed somebody to fix your TV, you should have married some tech boy," he added.

"Instead of my hotshot pilot?" Miriam laughed, stretching out an arm to her husband. She paused as she stood, and at the same moment both realized that the high-pitched keening they had associated with the television was now louder. The hardwood floor carried more of a buzz than a trembling. Miriam's smile froze into a part of her human architecture, like the ferrous curls of hair framing her face.

Earthquake? thought Stone as two strides carried him to the south door. Not in the Smokies, surely; but politics had taught him even more emphatically than combat that there were always going to be facts that surprised you, and that survivors were people who didn't pretend otherwise. He threw the door open. Whipsnake Ridge dropped southward, a sheer medley of grays formed by mist and distance. The sky should have been clear and colorless since the Moon had not yet risen, but an auroral glow was flooding from behind the cabin to paint the night with a score of strange pastels. The whine was louder, but none of the nearby trees were moving.

"Miriam," Stone began, "you'd—"

The rap of knuckles on the north door cut him off.

"I'll get it," Miriam said quickly.

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"You'll stay right here!" the senator insisted, striding past her; but her swift heels rapped down the hallway just behind him.

Stone snapped on the entryway light before unlatching the door. The cabin had no windows to the north as the only view would have been the access road and a small clearing in the second-growth pine of the Ridge, a poor exchange for the vicious storms that ripped down in winter. The outside door opened into an anteroom to further insulate the cabin, and that alcove, four feet square in floor plan, was filled by two men in black uniforms.

"You will forgive the intrusion, Senator and Madame Stone," stated the foremost in a rusty voice more used to commands, "but we could not very well contact you in more normal fashion in our haste." The speaker was as tall as Stone, a slim ramrod of a man whose iron-gray hair was cropped so short as to almost be shaven beneath the band of his service hat. The dull cloth of his uniform bagged into jackboots as highly polished as his waist-belt and pistol holster. It was not the pistol, nor the long-magazined rifle the other visitor bore that struck the first real fear into Stone, though: both men wore collar insignia, the twin silver lightning-bolt runes Stone thought he had seen the last of thirty years before. They were the badge of Hitler's SS.

"May we enter?"

"You go straight to Hell!" Stone snarled. His left hand knotted itself in the nearer black shirt while reflex cocked his right for as much of a punch as desks and the poisonous atmosphere of Washington had left him. The second Nazi was as gray as the first and was built like a tank besides, but there was nothing slow about his reactions. The barrel of his rifle slammed down across Stone's forearm. Almost as part of the same motion the stock pivoted into the senator's stomach, throwing him back in a sprawl over Miriam's legs. The entranceway light haloed the huge gunman as he swung his weapon to bear on the tangle of victims almost at its muzzle.

"Lothar!" the slim German shouted.

His subordinate relaxed. "Ja, mein Oberführer," he said as he again ported his rifle.

With a smile that was not wholly one of satisfaction, the black-shirted officer said, "Senator, I am Colonel Ernst Riedel. My companion—what would you say—Master-Sergeant Lothar Mueller and I have reached a respectable age without inflicting our presence on you. I assure you that only necessity causes us to do so now."

Stone rose to his feet. Riedel did not offer a hand he knew would be refused. Miriam remained silent behind her husband, but her right arm encircled his waist. Stone looked from the men to the rifle used to club him down. It was crude, a thing of enameled metal and green-black plastic: an MP-44, built in the final days of the

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Third Reich. "You're real, aren't you!" the senator said. "You aren't just American slime who wanted something different from white sheets to parade in. Where do you hide, Nazi? Do you sell cars in Rio during the week and take out your uniform Sundays to look at yourself in the mirror?"

"We are real, Senator Stone," Riedel said through his tight smile. He raised his left cuff so that the motto worked on the band there showed. It read "Die Letze" in old-style letters. "We are the Last Battalion, Senator. And as for where we hide—that you will know very shortly, for we were sent to bring you there.

"Madame Stone," he went on formally, "we will have your husband back to you in days if that is possible. I assure you, on my honor as a true Aryan and before the good God and my Leader, that we mean no harm to either of you."

"Oh, I'll trust your honor," Miriam blazed. Fifteen years as a senator's wife had taught her the use of tact, but nothing would ever convince her that every situation should be borne in silence. "How many prisoners did *you* shoot in the back at Malmedy?"

For the first time, Riedel's chalky face pinched up. "It is well for you both, Madame, that Mueller does not speak English." He added, "You may trust my honor or not, as you will. But it is not in our interests alone that we have been sent to you, nor in those alone of the country you represent. If we fail, Senator, there may well in a short time be no Aryan life remaining on Earth."

His hand gestured Stone toward the door. "You will please precede us."

Without hesitation or a backward glance, Stone brushed past the two Germans. Had he looked back he would have called attention to his wife, erect and dry-eyed in the hall. He had known enough killers while he was in service to realize that Mueller's bloodlust was no pretense. The big man had been a finger's pressure away from double murder, and they would not have been his first.

The outside door opened and dragged a gasp from Stone in the rush of warmed air. Instead of the clear night sky, a convex lens of metal roofed the clearing a dozen feet over Stone's head. The size of the clearing gave the object dimension: it was a two-hundred-foot saucer resting on a central gondola and three pillarlike legs spaced halfway between the center and the rim. Through the windows of the gondola could be seen other men, both seated and standing. An incandescent light flooded stairs which extended from the gondola to the ground, but the whole scene was lighted by the burnished iridescence of the saucer itself.

Behind Stone, the Nazi officer laughed. "It is not heat so much as the eddy currents from the electromagnetic motors that make the hull plates glow so handsomely. But walk ahead, please, Senator. She glows as much on the upper side as well and we—we do not wish to attract close attention

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while we are grounded."

Stone's carpet slippers brushed crisply through the ankle-high grass. The dew that should have gemmed the blades had evaporated under the hot metal lid. Stone always wore slippers and pajamas when he did not expect company, but it was one hell of an outfit in which to take the surrender of a batch of Nazi holdouts in a flying saucer.

Except that Stone knew inside him that men like Riedel were not about to surrender.

"This is Dora, the largest of our experimental models," Riedel said with pride. "She is sheathed with impervium—chromium–vanadium alloy, you perhaps know. There is no limit, nearly, to the speeds at which she may be driven without losing the strength of her hull, even in the thickest of atmospheres."

Closer to the gondola, Stone could see that it rested not on wheels but on inflated rubber cushions that must have been heavily reinforced to bear the weight of the craft. There were small signs of age visible at a nearer glance, too—if Dora was experimental, it was an old experiment. The rectangular windows whose plane surfaces suggested glass or quartz instead of nonrefractive Plexiglas were fogged by tiny pits, and the stair runners appeared to be of several different materials as if there had been replacements over the years. All the men in the gondola were bald or as gray-haired as Mueller and Riedel. The colonel noticed Stone's surprise and said, "Everyone volunteered for the mission, but we Old Fighters, of course, had preference. Everyone here was of my original crew."

The man who reached through the hatch to hasten Stone up the last high step wore gray coveralls from which any insignia had long been removed, though his air of authority was evident. He was not even middle-aged. His hands were thin and gnarled, their hairs gleaming silvery against the age-dappled skin, and the bright lights within the gondola shadowed his wrinkles into a road map through eighty years. His exchange in German with Riedel was quick and querulous. The colonel did not translate for Stone's benefit, but tones and the flash of irritation in the eyes of both men explained more than the bland, "Over-Engineer Tannenberg is anxious that we be under weigh. You will please come with me to the control room. We will have time to discuss matters fully after we have lifted off."

All ice and darkness, the Nazi strode to one of the pair of latticework elevators in the center of the gondola. Flipping one of a bank of switches, toggles instead of buttons, he set the cage in smooth but squealing upward motion. Wholly fascinated, the senator stared around him.

A bell pinged each time the cage rose to another level. Through the sides, Stone saw identical masses of copper and silicon iron, suggesting the inside of a transformer rather than the computer room the craft's gleaming exterior had led him to expect. Nar-

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row gangways threaded into the mass, and twice Stone glimpsed aged men in stained coveralls intent on their hand-held meters. There was nothing subtle in the vessel's layout. It reeked of enormous power as surely as it did of ozone and lubricant. There were eight levels above the gondola, each of them nearly identical to the others, before the cage pinged a ninth time and grated to a stop.

"Sit there, please," Riedel directed, gesturing toward a frame-backed couch that looked unpleasantly like a catafalque. Stone obeyed without comment, his eyes working quickly. They had entered a circular room fifty feet across. Its eight-foot ceiling was soundproofed metal, but the whole circumference was open to the world through crystalline panels like those of the gondola. The saucer, domed with more of a curve on the upper side than the lower, was a fountain of pale iridescence against which the grim SS runes stood out like toppling tombstones.

A dozen preoccupied men shared the control room with Stone and Riedel. Sgt. Mueller was one of them, looking no less dangerous for having put aside his rifle. The others appeared to be officers or gray-suited engineers like Tannenberg. Three of the latter clustered in front of a console far more complex than those sprouting from the deck beside the other benches. One of the men spoke urgently into a throat mike while his companions followed the quivering motions of a hundred dials apiece.

Riedel stood, arms akimbo, and snapped out a brief series of orders. The heavyset man nearest him nodded and began flipping toggles. All three of the engineers were now speaking intently in low voices. Lights dimmed in the control room, and the air began to sing above the range of audibility.

Stone felt his weight shift. Trees climbing into the night slanted and suddenly shrank downward. Stone's cabin was below, now, visible past the glowing dome of the saucer. Lone in the pool of the yard light stood Miriam, waving her clenched right fist. Then the disk tilted again and Stone was driven flat onto his bench by a vertical acceleration not experienced since he had reached the age limit and could no longer zoom-climb a Phantom during Reserve training. The sensation lasted for longer than Stone would have believed possible, and by the time it settled into the queasiness of steady forward motion, the sky had changed. It was black, but less from the absence of light than the utter lack of anything to reflect light.

Riedel was returning. "Not bad," Stone said with a trace of false condescension, "but can you outrun a Nike Zeus?"

"The Russian equivalent, yes indeed, Senator," replied the German, capping Stone's gibe. "Each couch"—his gesture disclosed rubber lips edging the top of the bench—"can enfold a man like an oyster's shell and hold him in a water suspension. For the strongest accelerations we use even a fluid breathing medium, though of

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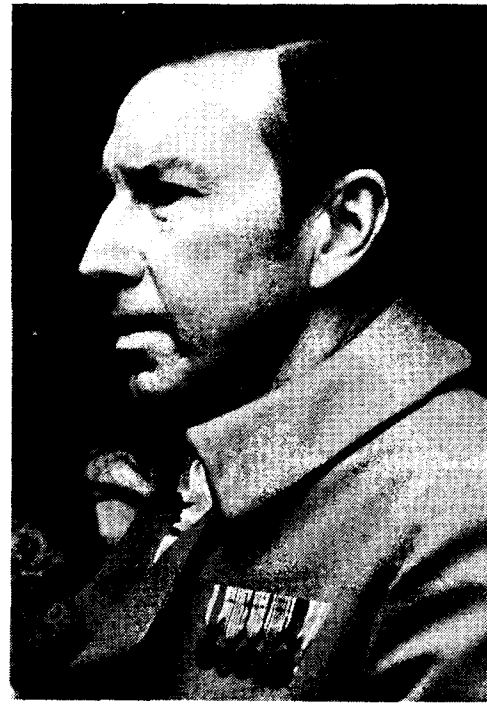
course"—and Riedel frowned in concentration at the thought—"that requires time for preparation that we do not always have."

He seated himself beside Stone. The American blinked, more incredulous than angry at what seemed an obvious lie. "You expect me to believe that this—my God, it must weigh a thousand tons! *This* could outaccel-



● *Keith Laumer*

Anyone who sells the first story he ever wrote is obviously cut out to be a writer. That's Keith Laumer. A long-time reader of science fiction, he started writing in 1959 and soon brought onstage one of the great characters of science fiction, Retief.

Keith was in the U.S. Foreign Service, mostly in Burma, and before that he was in the U.S. Air Force, reaching the rank of Captain. Like Retief, Keith is a man of indomitable will, and is endowed with great energy. These served him in good stead as he fought his way back from a paralyzing stroke six years ago. Not only did Keith recover his ability to get around unaided, but he continues to turn out good science fiction. His novella, "The Wonderful Secret," which begins in this issue, is the first part of a novel to be published later this year, titled THE ULTIMAX MAN.

Keith's nonscience-fiction works include the contemporary novel, EMBASSY, and his book on model airplanes, HOW TO DESIGN AND BUILD FLYING MODELS, which is a classic, perhaps the definitive word on the subject, and is still in print after seventeen years.

Also trained as an architect, Keith designed his home, located on an island in a Florida lake. Inside, much of the furniture has been designed and built by Keith himself.

Determination, intelligence, ingenuity, and a distaste for incompetence are all traits shared by Keith and Retief. And if on occasion Keith has turned up at parties wearing formal Terran Embassy attire, neither man suffers from the identification.

Jay Kay Klein's BIOLOG
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erate an antimissile missile?"

Riedel nodded, delighted with the effect he had made. "Yes, yes, the power is here—is it not obvious? That was Schauberger's work, almost entirely. But to make it usable for human beings took our Engineer Tannenberg." The colonel chuckled before adding, "Have you noticed that when men of genius grow old, they become more like old women than even old women do? Tannenberg is afraid every moment we are not aloft that the Russians will catch us."

The earlier name had snagged Stone's attention. "Schauberger?" he repeated. "Sure, I remember him. In the fifties he was touting an implosion motor or some damned thing. I remember a major from Wright-Patterson telling me about it. But then nothing came of it."

"But then your FBI questioned poor Viktor with, shall we say, a little too much enthusiasm," Riedel corrected with a tolerant smile, "and he was reported beaten to death by Chicago hoodlums. The implosion motor was only a smokescreen, though, for the electromagnetic engine he had already developed for his Führer. Think of it, this craft and these mighty engines that you see filling it—able to draw fuel from the Earth, from the very fabric of space itself!"

"If that were true," Stone said carefully, "I frankly don't see why you would need me." He chose his words to deny what he feared, that the story was as solid as the steel floor beneath his feet. To admit that aloud would gratify this colonel whose arrogance only slightly increased the disgust Stone already felt for his uniform.

The implied question reminded the Nazi sickeningly of his mission. He sighed, wondering how much to tell the fellow now. Stone was the only man short of his unapproachable president who had enough power with military and political leaders to act with the necessary swiftness. Without his willing cooperation, more than the whole Plan was a ruin. "At first we were based at Kertl," Riedel began, "where the airframe had been fabricated." He was avoiding a direct answer partly in hope that it would somehow become unnecessary if he explained the background. Riedel owned to few superiors, but there was One—and of late, with age and the pressure He bore most of all of them, that One had displayed an ever-lowering acceptance of failure. "The engines arrived by train, at last, from Obersalzberg, and we worked all night to unload them before the bombers came."

Riedel laid his service cap beside him and scrabbled the fingers of his left hand through hair that for thirty-seven years had been cropped to between five and ten millimeters' length. While everything else had changed, that precision had not. "There was no time to do what was required—you have seen the engines—but we did it anyway. It was like shifting mountains with a spoon to emplace them in the airframe using the equipment we

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had, and all the work underground as well. But in those days the impossible was normal, and we were Waffen-SS. The time that we had was being bought for us with the lives of our comrades on the front lines, fighting tanks with hand grenades."

Of the men in the control room, only Sgt. Mueller was openly watching Stone and Riedel; but the inattention of the others was the studied sort, that of jackals waiting for lions to end their meal. All of the crew understood the importance of their mission.

"The final order came by courier from Berlin, an SS major with an attaché case in the sidecar of his motorcycle. It had been chained to his right wrist, he told us, but the shell that killed his driver had taken that arm off at the elbow. With teeth and one hand he had tourniqueted himself before retrieving the case. The orders were not those we expected, but in the face of such dedication we could not have refused them."

"You ran," Stone interjected flatly, knowing that truth would twist the edged words deeper than any emphasis he could give them.

"We took off in three hours," the German said, his face a block of gray iron. "It was the first time, as soon as final engine hookups had been made. All of us were aboard, even the kitchen staff. Everything worked. I could not believe it—five years of design and construction, and then no flaws. But again, there was no choice. From the air we could see British tanks already within three kilometers and nothing but the forest itself to slow them. Had we left fifteen minutes later, they might have captured our base before the demolition charges exploded."

"What you seem to be afraid to admit," Stone pressed, "is that a single plane—saucer, whatever—isn't worth a damn no matter how advanced it is." He stood, a commanding presence again now that he had recovered his poise. The mass and smooth power of the vessel made its speed a matter of only conscious awareness. "It's only a bargaining chip, to be sold to one side or the other since you can't develop it yourself. And we and the Russians both will soon have equipment in the air that will match it, so you're running out of time to deal."

"You are incorrect to assume we are alone," Riedel said, as careful as the American to avoid theatrical emphasis that would only give truth a false patina. "We escaped alone, but there were fifty-three submarines of Type XXI—no, I do not exaggerate—that could run submerged all around the world with their snorkels. They carried above 3,000 persons, couples and young people, out before the Russians captured Danzig; and in Norway they picked up . . . some who had flown by jet out of Tempelhof just at the end."

Stone licked dry lips but his voice was firm as he insisted, "Even then they couldn't go anywhere. I've heard about the money Himmler was spreading around in South America,

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but even so there wasn't a country there that could have hidden such a fleet without word leaking out. A fleet needs a base."

"It has one." It was time for the final hammerblow of truth. "In New Swabia, where we met them."

"Huh?" grunted Stone, surprised and uncomprehending.

"Imbecile!" snarled the Nazi, seeing all his preparation threatened by his listener's ignorance. "In Antarctica, Queen Maud Land as you and your Allies call it! Kapitan Ritscher explored it in 1937 and we have held the interior since, no matter what color the coast is painted on a pretty map. And there is one other place we have been for twenty years, my good Senator," Riedel said, loudly now and wagging his finger like a pedant's pointer, "though others seem to believe they were the first there."

He paused, breathing very rapidly. "This vessel is not limited to the atmosphere, Senator; indeed, we are above it now to all intents and purposes. We have a base on the Moon where we have manufactured a hundred ships of this design!"

But as Stone's jaw worked in stunned silence, Riedel's pride too dissolved in despair. "We had a hundred, yes," he repeated, "but the Russians have a thousand, and they are destroying us. You must help us fight them, or Aryan man is doomed."

The sky was an emptiness that would have been violet if it had color. Pits on the crystal windows prevented the stars from gaining any real body, but a slight course correction brought the Moon in sight to port. It was gibbous and the gray of fresh-cut lead. "I don't believe that," Stone insisted. "I've made it my business over the years to know about Russian strength. Our intelligence people trust me. They aren't lying to me, and notwithstanding all the nonsense my colleagues and the media like to spout, the Russians aren't fooling our people either. Besides, if the Reds had a whole fleet like this, we'd have learned about it the hard way long since. Unless there's more to détente than *I've* ever believed."

Riedel shrugged. " 'When one has eliminated the impossible . . . ,' " he quoted, then paused to consider how he should continue. Stone's logic was impeccable, its only flaw being Russia's unfathomable, senseless subtlety in not showing an apparently pat hand. Riedel had not believed it at first, either, but facts were facts. "At the first reports in 1947, we thought rumors of our Dora, here, were being retailed in garbled form," he explained. "At the time, we had only the one ship—no others had been completed before the final holocaust, and the Antarctic base was not suitable for manufactures this major. It was not until we could process aluminum on the Moon that we could expand, and that was five years later.

"There were too many reports. We were very careful with Dora, you must understand; and though we had our contacts with the world outside, no one beyond the Battalion knew any-

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thing except our Plan, to control the balance when at last East and West joined in Götterdämmerung." Riedel's face gleamed with the sweat of earnestness. He brushed at his face and extended both thin hands toward Stone. "Our rocket scientists, you and the Russians had captured; but we thought all but the least word of the Diskus Projekt had been hidden. Now we began to fear that the other sightings were more than imagination, and that our secret had escaped."

"You never saw them yourselves?" Stone asked. "The other UFOs, I mean?"

"I did," Riedel said, pride warming his words. "We had completed the first disk to be built on the Moon and I was flight-testing it. Because we expected fleet maneuvers in the future, Engineer Tannenberg had coupled a locator to the engines to display other users of the spectrum—our own vessels, we intended. But as we began our first atmospheric approach—" and Riedel lived again the moments as he described them to Stone:

In a voice as wizened as his face, Tannenberg had announced, "Colonel, there is another ship within a kilometer, at five degrees to our heading and a little lower."

"Nonsense!" Riedel snapped. At thirty kilometers altitude their test craft could have encountered only Dora, and she would have been a bright dot on their radar screen.

A bead glared suddenly against the screen's green background. It was near them, much closer than it should have been before being picked up in the radar's fifteen-second sweep. "Navigation!" he called, his temper that of a wounded bear looking for a victim. First trial of the new hull in the pressures and powerful magnetic fields of Earth was a tense enough business without having unknown vessels slip through undetected.

"S-sir," said the white-faced technician at the main radar display, "it just now appeared."

"Colonel," Sgt. Mueller said, his hair-spined forefinger pointing downward into the blue-white haze into which their craft was descending. Metal winked, a reflection with no definable color.

"It's off the screen again!" the fearful radarman was bleating, but Riedel's voice cut through his junior's without hesitation: "Attention! All crewmen to acceleration couches! Sergeant Mueller, arm the rockets and stand by." Disconnecting his throat mike, for he spoke to himself rather than his men, Riedel added, "They think to play with us, do they? Well then, we will play with them."

Only Sgt. Mueller heard, and he grinned a wolf's grin as he ran his hands over the switches of his console.

At 300 meters, the black, portless hull of the foreign disk was stark against the sky-curve beyond. It bore no marking. Both craft were steady at a little over 1800 kph, far below the capacity of Riedel's engines. This was not his Dora, though, he thought with

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rage. Impervium hulls were beyond their ability to forge on the Moon—or on Earth without arousing the interest of the nations who had to be lulled into forgetfulness. Aluminum was cheap, given lunar ores and abundant power, but the new hulls could not stand the friction heating of 4,000 kph or more in the atmosphere.

"Unknown craft, identify yourself," Riedel ordered in German. He was broadcasting only on eleven meters, but with a 10 kw transmitter driving his beam, even the light bulbs on the other craft would be repeating his words.

There was no response. He tried again in English, for they were over northern Canada. All his subordinates but Mueller had slipped into their clamshell couches, taking their information from the gauges slaved into the panels over their faces. Riedel started to rebuke the sergeant, then realized that with the enemy able to evade radar, only visual control could be used for the rockets.

And there seemed little doubt that the black disk was an enemy. "Does anyone aboard speak Russian?" No one answered. Besides, what did they have to discuss with the conquerors of Berlin? "Fire one, sergeant," Riedel said evenly.

Mueller's finger stroked a 20 cm rocket from the ventral weapons bay. Its hundred kilos of explosive could be wire-guided 5,000 meters, but the gap between the two ships was point-blank range.

The charge went off scarcely halfway to the black vessel.

The spurt of red on black smoke, half a second early, was a greater surprise to Riedel than the howl of air through the fragment-riddled panels before him. The missile's own fuse should not have armed at so short a distance. Something invisible surrounding the other craft had detonated the weapon while it was almost as dangerous to its user as its target, and the target was diving away. Riedel followed, ignoring for the moment the stresses to which he was subjecting his ship and his own unshielded body. Sgt. Mueller had yanked down a whole handful of switches and four guidance flares leaped together after the black craft. It wobbled under the multiple shockwave, but a beam as pale as an icteric sclera needled back from its dome. Riedel saw the hull directly in front of him boil away as the laser struck it. His instant course change bagged his cheeks and flattened his eyeballs. The black vessel did not attempt pursuit.

The executive officer in his acceleration couch had taken over when Riedel regained full consciousness. They had resumed their planned course toward Antarctica, flying below 2,500 meters because of the gashed hull. Sgt. Mueller was clenching his hands in fierce frustration. "We need something better to kill them with," he kept repeating.

"And we got it," Riedel concluded, affect raining out of his voice. "Tannenberg said his detector could easily

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be modified to cause a surge in other electromagnetic engines, to cause them to vaporize. For twenty-three years he was right and we hunted the Russians throughout space. There were losses, since their lasers could very quickly slit the hulls of the ships we built—not a bad weapon, lasers; we might have fitted our bases with them sooner had not Tannenberg's induced overloads left so little of their targets." He paused in an aura of satisfaction, looking out over the clean, black sky but seeing something very different. "From a pip of light the disks we destroy become great expanding balls that are all the colors of the rainbow. In atmosphere even the copper burns, so intense is the energy released."

"You bastards," Stone said with utter conviction. "I wonder if you'll find it so pretty when *they* come up with your gadget?"

"Colonel, we are closing with another vessel," broke in one of the crewmen.

"It may be ours. We were to have an escort when we reached open sea, if the situation permitted it," Riedel replied on his throat mike. To Stone he continued, "The Russians are an ignorant people, able only to steal from their betters. In all that time they have not duplicated the weapon."

He took a deep breath, adding, "But six months ago, they found a defense against it. And since then only the few lasers for which we have been able to buy components have kept them from our bases."

"You can't be serious," Stone said. But Riedel's mind was like his body—gray and honed and rigid. He could no more accept the superiority of an "under race" than could a computer which had been misprogrammed to deny it. That quirk has caused Riedel and his men to ignore the obvious. "Look, lasers—I don't know how long we've had them, but they weren't weapons back in 1950. And this detonator screen or whatever, *we* damned well don't have it now. If—"

"Colonel! The ship is not one of ours. It is closing!"

"Couches!" Riedel ordered. He stood, pressing as he did the switch that turned Stone's bench into an enveloping cushion. "Raise your legs and lie down, Senator. The television will show you what occurs, and we will release you as soon as possible."

The hull curve, a smooth violet as Riedel strode to his station, suddenly blazed white in a meter-long knife edge. The impervium alloy held, but Dora's evasive action in response to the laser thrust hurled the slender officer to the deck. He gripped a chart table, then let skewed acceleration fling him in the direction he wanted to go. He was safely within his couch before the third zigzag snatched at him.

"Riedel," he announced, "taking command." His fingers caressed switches they knew by touch. The enemy craft was an eddy in the frozen blue swirls of Earth's magnetic fields pictured on the detector screen. Rie-

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del set the television cameras to track the detector anomally though he would not need the picture. By the time Dora had been retrofitted with television, he was used to being guided to battle by the detector alone. And even with their surge weapon ineffective, there would still be a battle with Riedel at the controls. He knew his Dora.

The other craft was within two kilometers now. It fingered Dora's hull with another short burst, probably unaware that its target was more refractory than earlier victims. The Nazi commander's face was a grinning death's head within his couch as he cut forward thrust and flipped Dora to spin like a coin toward the icecap twenty kilometers below. The blue eddy danced around the center of the detector screen and the TV began to flash images of a black disk seeming to approach at a thousand angles. Fluid-filled membranes clamped down on every surface of Riedel's body, but still the maddening spin worked on his ear canals and the colloid of his brain itself.

The eddy was almost in the center of the detector. Riedel's fingers acted more through instinct than by conscious calculation. On the television, the spinning edge of the black vessel froze and expanded. There was a terrible, rending crash as Dora's impervium edge buzz sawed into the unknown material of her enemy's hull. A sheet of white fire enveloped both craft as the chrome-van alloy proved tougher than what it impacted. Objects vomited from the spiraling gash in the hostile craft. One of them tumbled almost against Dora, now motionless as her enemy fell away from her. The thing was momentarily alive and quite visible on the television screens. It was about nine feet tall, with four limbs that looked like ropes knotted over a thin framework. Its mouth was working and its eyes glittered fear of death through each of their facets.

"You butchers," a voice rasped through Riedel's earphones. His anger awakened him to the fact that he still had Dora to pilot, and the anger faded when he realized it was the American who had spoken and not one of his crewmen. "It wasn't enough to fight the whole rest of the world. You Nazis had to start an interstellar war."

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There was an air leak between compartments F-87 and F-88; a bulkhead had crumpled but the outer skin, though indented, was not seriously torn. Riedel touched switches. As his acceleration couch withdrew into itself, Dora plunged down as smoothly as an elevator and swiftly enough that her passengers neared the weightlessness of free fall.

"Murderers! Criminals!"

Riedel ripped out the jack of his headset. In two steps he had snapped the outside latch on Stone's couch, effectively silencing and isolating the senator. "Lieutenant Wittvogel," he ordered, "raise the base. Secrecy is no longer necessary."

"No reply, sir," the tall communications officer called across the room. "Not even to the emergency signal."

"We're within fifty kilometers," Riedel said, but he spoke under his breath. "Keep trying," he ordered.

With an atmosphere to scatter it, sunlight and its reflection from the ice below blazed through the windows. The computer installed three years earlier—a massive thing, not a sophisticated "black box"; but Dora was not a volume-starved turbojet—was guiding them back at 3,000 kph and there was no need for Riedel to stare tensely into the rippling whiteness they skimmed. Beside him stood Sgt. Mueller, as silent as a bored sentry. He had been out of his couch before his commander. When Stone had been locked in, Mueller's responsibility had ended and he had relaxed with a grin. Even so, it was his ease rather than Riedel's stark anticipation that caught the first sight of the base.

"Sir, there's something ahead there that glows!"

Riedel took instant manual control, cutting speed and raising Dora to a kilometer's altitude. They circled the glow, banked inward for observation rather than flight necessity. A hole had been blasted in the ice, four kilometers across and of a depth obscured by the boiling lake that snarled at its rim.

"The Führer," Sgt. Mueller whispered. He jacknifed and vomited across the deck plates. Lt. Wittvogel had hurled away his microphone and, like several of his fellow crewmen, was openly weeping. Riedel himself was the least visibly affected, but as he unlatched Stone's prison he muttered, "I wonder if we taught them about the Bomb, too. They were such bad fighters, no instinct for it at all . . ."

Riedel was back at the controls,

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following at full speed and a kilometer's altitude the brown rim of beach against gray-green water, when Stone touched his shoulder. "You're done now, aren't you?" the American said softly.

"He could have escaped. He could be at the Moon base now—perhaps they had only one bomb. He—" Riedel's throat choked him into sudden silence.

"He?" Stone echoed. His face went as white and cold as the ice below. "I fought three years for a chance to kill—that one. If these others have done that, they have my thanks. Whatever else they intend."

On the horizon was a small freighter static in the shadow of shear, snow-browed cliffs. Inshore of it were a huddle of Quonset huts set in a splotch of snow dirtied by human habitation. "I swore an oath to your wife," Riedel forced out through tight lips, "and I would prefer to keep it. But if you say another word, Senator, you will go out at a thousand meters."

The landing legs squealed while Riedel's practiced fingers brought the disk to a hover over the Quonsets. "Wohlman," the colonel ordered abruptly, and his executive officer took the controls with a nod.

"What will you do now?" Stone asked as he stepped to the elevator in anticipation of a command.

"The Moon base will need us," Riedel said, his black and silver chest separated from the American's by an invisible wall of grief.

"If it's still there. They would have hit it first, wouldn't they?"

The cage ground to a halt in the observation gondola. The four men there were tense, hands close to their sidearms. "Inform your people, Senator," Riedel said. He riffled a worn, mimeographed book, then handed it to Stone. "Our maintenance manual. Perhaps your experts can construct their own disks from it. I have nothing better to offer you here."

Men in furs were running out of the huts. A blast of dry, chill air hammered the compartment as the hatch opened and the stairway extended. "These are Argentinians. At this time of year you should have no trouble getting a swift return to your country."

"But what are you going to do?" Stone insisted, the rubberized treads warm under his feet though the wind was a knife across the rest of his body.

Riedel's eyes, colder than the ice, thrust the American down the gangway. "Do?" he repeated. "We are SS, Senator. We will continue to fight."

Dora was rising again even before the stairs had fully retracted. A dozen startled Argentinians clustered around Stone, their parka fringes blending indistinguishably with their bushy facial hair. Around them all a huge disk had been etched in the powdered snow by the radiant metal above it.

The Antarctic sky was clear, except for a speck that vanished even as Stone's eyes followed it upward. ■

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pinocchio

A true nonhuman intelligence would hold up a much-needed mirror to our own ways of thinking

Stanley Schmidt

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Day 14, Month 5, Year 3
[New Age]

I'm afraid I've been neglecting these notes since the Kyyra started moving the Earth to M31, and especially since we reached the second acceleration plateau. I could rationalize it by saying that the paper and ink we stockpiled isn't going to last forever, which is true. (I've been consciously writing very small when I do write.) But the real reason is that so little has been happening these last months that it's driving us up the walls, and writing about it only makes it worse. Well, this trip up north is something happening, and I'm going to keep full, careful notes, if only for the duration.

It's funny what makes an impression on people. I think what thrilled me the most about the invitation was the fact that Dr. Orlik said I should bring a bathing suit. I still have one—a nice orange bikini I'd only worn twice—but I never expected to get to use it again. At home we never get any closer than sponge baths now, and even that too seldom. I really need to get away, and the prospect of enough water to get all the way into is Elysian.

I'm only sorry Jonel can't come too. But, much as I hate to say it, I even need to get away from him for a while. And he needs to get away from me. There's so much we have to sort out.

And I'm not at all sure how I'm going to react to meeting Pinocchio.

Flipping back through these pages, I notice this has all happened so fast I haven't given a very coherent account of just how it came about. I'll have to try to fill it in as I go, in case anybody (including me) tries to read this years from now. But time's still going to be a problem, I suspect. After all these months of so little to do (imagine *me* complaining about *that!*), I'm going to be busy.

But I do have a little time now. We're here, and I'm alone in my room and more than ready for sleep. But I really should try to finish what I started on the plane before I turn out the lights.

Beldan came with me; he said it was his duty as the Kyyra ambassador when he heard there was another intelligent race involved. (Of course, I know it goes deeper than that . . .) Anyway, we came up in Henry Clark's official plane, the same little yellow twin jet Tony's been flying for him for as long as I've known him. Henry doesn't use it much any more—even he doesn't travel unless absolutely necessary now—but he tries to keep it in shape and Tony in practice. As emergency administrator of Earth, he has to be able to go anywhere fast if the need should arise. He's had to have it modified, of course—altimeter revamped to compensate for latitude, jets souped up to let it fly in thinner air, fusion rocket boosters to help it when it has to go so high that even the modified jets aren't enough.

We did that once today. I wanted to see my old cottage in the Tennessee

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mountains, near the Carolina line. It was out of the way, but Tony said it wasn't too far, so we swung inland. And as we started up over the Appalachians, he cut in the rockets, even though we would only clear the highest peaks by a thousand feet. There isn't really that much less air, yet, but most of what there is, is in the southern hemisphere.

We passed my place around noon. There wasn't anything to see out the windows, of course, except blackness and stars (and we could see those, because we were flying with no cabin lights except the soft glow of the instruments). But the plane now has an infrared ground scanner with an image intensifier, and Tony let me come up front so I could see the screen. I watched it intently, but I'm not sure it was a good idea. I recognized the hills, and I even caught a glimpse of the cottage where, less than three years ago, Jonel and I had looked forward to living. But it was a different place now—the mountains which should have been alive with sunshine on soft greens and pinks now held nothing but darkness and black skeletons and death.

There was a lump in my throat and something in my eye as Tony turned the scanner off. I went back to my seat next to Beldan and we turned northeast. I guess I could have written some more then, but I didn't feel like it, and none of us talked much the rest of the way.

We had a smooth landing at Hyannis, uneventful except for the striking effect of flying over a landscape of almost complete darkness and having an entire airport outlined in bright lights spring suddenly into being at Tony's request. It was beautiful. (Flights are so infrequent now that few airports keep their lights on except when they know somebody's coming in or leaving.)

We put on respirators before we got out of the plane. There's still enough air to breathe, for short times, but the quality isn't what it used to be. No point in taking chances, Tony says, and I suppose he's right. So we put them on, and I felt like a caricature of a nurse going into an operation as we got our feet back on the ground. Tony said good-bye and went to the pilots' lounge to rest up before taking the plane back to Kennedy.

Henry doesn't worry about keeping Beldan out of sight when he leaves the spaceport any more. Everybody knows who he is now, and presumably everybody knows we can't get along without him, now that we're committed to the trip. In ways, I prefer the new openness, but sometimes I wonder about it. There are still enough nuts in the world that someday one of them might take a potshot at an alien just because he's an alien. Rational arguments have little effect on such people.

Luckily, most of them—like virtually all of us—are confined under what might as well be called house arrest. So I guess the danger isn't really very high.

Anyway, the car that had been sent

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to meet us was an ordinary car, and we walked like ordinary travelers through the airport corridors and out to the parking lot. But our car was the only one there, and our driver was the only other person in the halls. He'd been wandering around looking for us, not sure where we'd come in. When he saw us come in the gate he ran to catch us. He gave Beldan's flamboyantly-robed seven-foot form a wide-eyed glance, tried to cover it, and looked straight at me. "Excuse me," he said. "Are you Sandy Turabian?"

"Yes," I said. "And this,"—I gestured—"is Beldan."

"Awfully glad to meet you, ma'am," he gulped. "And you, too," he added hastily to Beldan. It took a slight effort to keep from laughing at his flustered state. He kept casting furtive, curious glances at Beldan, as if he'd never seen a Kyyra in the flesh before. (Which was undoubtedly the case—very few people have.) "I'm Bill Maracek," he told us. "I've a car outside to take you to the Institute."

It was an electric car, of course. You never see anything else now, even if you happen to be out; internal combustion engines don't run well enough to be worth the trouble. Unfortunately, it wasn't a very big car, so Beldan had to scrunch up in a way that couldn't have been very comfortable. Luckily it wasn't a very long ride: It's not very far, the road's pretty good (though the surface could use quite a bit of work), and there was no traffic and no traffic cops. We didn't see a single moving car on the whole trip, even in downtown Falmouth.

There wasn't even a parking problem in Woods Hole—we could have any place we wanted! A far cry from the one other time I was here, when I came down as a girl to catch the ferry for the Vineyard with my uncle and we spent so much time looking for a parking place that we almost missed the boat. But then everything's a far cry from what it was then. The ferries have long since been cannibalized, and there's no water between here and the islands—or a long way beyond.

Seeing that at close range, I think, made arriving here even spookier than flying over the cottage, even though I had lived many very happy months there and only visited here once. It wasn't cold, but I shivered as we parked in front of the main building of Oceanographic, with lights on in a few thick windows, and got out onto the deserted street.

Water Street, I thought, reading the sign up at the corner. *None of the names fit any more. Water Street, with no water in sight. Oceanographic, with its ocean miles and miles away, and in the late stages of dying.*

I looked up. *And a stunning, chilling Milky Way in the middle of the afternoon.* I tried not to think about it, but the thoughts tumbled through well-worn grooves before I could stop them. *The Sun's still back there; they still see it in the southern hemisphere, as the pole star they never had before. A* bright *pole star—as bright as the*

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full Moon used to be—but just a pinpoint to the naked eye.

And only faith tells us northerners it's still there at all. But it is—six or seven hundred astronomical units back. We've come that far—which only leaves a couple of million light-years to go.

Or a couple of hundred million times as far as we've come.

No wonder I feel like we're not getting anywhere.

I shook the thought out of my head and followed Bill Maracek. It was about time I concentrated on what I'd come for—I should have been excited about it, yet I hadn't actually thought about it since we landed at Hyannis.

The dolphin facility was right across the drawbridge, the rusty old drawbridge that has nothing to do now. The channel under it, formerly connecting Eel Pond to open water, was not just a deep, ugly gash in the Earth. One orange brick wall of the building formed a side of the gash, extending well below the former low-water line. Near the bottom was an elaborate gate arrangement, now tightly sealed, which I knew was where the participating dolphins had come and gone in the heyday of Mason Orlik's work. I hadn't seen the gate before—the building was still under construction when I was here fifteen or twenty years ago—but in the last couple of days I'd been reading about what Orlik had done here. Just how much he'd accomplished had come as quite a surprise to me—but then, the most important parts had happened in the last couple of years before everything changed, and he hadn't had time to publish it.

We reached the door, pressed a call button, and waited. I noticed the entrance had been fitted with both kinds of airlocks—the self-sufficient kind with its own cycling pump, and the cheaper kind with no pump but just a nipple for rescue crews and such to attach a portable when they need to get in or get somebody out. Here, presumbly, it's an emergency backup, but for most people it's all they have. Just one of the umbilical cords—along with power lines, recycling systems, radiophones, delivery chutes, and on and on—connecting them to this precarious makeshift civilization we've built to stay alive. If any one of the cords fails, the person or family attached to it dies, unless it can be fixed very fast. And they do fail sometimes, because it's all been built so hastily there wasn't time to get all the bugs out.

No wonder we feel vulnerable.

A voice from a rattly speaker asked who we were. Bill told it, and a moment later there was a hiss that ended in what sounded like a sigh of relief. The words PLEASE COME IN glowed at eye level, and we opened the outer door to go in and meet our host.

Mason Orlik is thin, wiry, intense-looking but soft-spoken, and so instantly likable I can't help wondering whether he had more reasons for ask-

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ing me to come than he's told me so far. He must be close to twice my age, but looks quite youthful, with smooth skin and close-cropped black hair cradling his face in a thin fringe beard with a sharp point at the chin. There's a little gray among the black, but not much, and it doesn't call attention to itself.

He rose from his gray steel desk as we walked into his fluorescent-lighted, book-and-tape-lined office. Beldan had to duck to go through the door, and Dr. Orlik gave him an odd glance that I didn't understand. But then his eyes came back to me and he smiled and extended his hand. "Terribly glad you could come, Mrs. Turabian. Mason Orlik, at your service."

I shook his hand. "I'm flattered that you asked me. I only hope I can help."

"If you can't, I'm afraid we'll have to give up." Close up, I saw that worry lines were starting to creep into his face. "I've heard so much about how you were the only human who could really talk to the Kyyra. And how helpful Caesar Clark has found yours and your husband's advice since all this started."

Caesar Clark, I mused. Lots of people call him that now, but the fear and hate with which they used to say it is so far gone from their voices now that it scares Henry. But Orlik didn't say it with quite the reverence some people do . . .

I shrugged. "He asks us what we think, we tell him. That's all. Dr. Orlik, I'd like you to meet Beldan, the Kyyra ambassador."

"An unexpected pleasure," Orlik said, extending his hand to Beldan. But his eyes said he wasn't quite sure. "I . . . er . . . didn't realize you were coming with Mrs. Turabian."

"Sandy," I corrected, trying to put him at ease. "I told your secretary—"

"I'm afraid she garbled the message a little," Orlik apologized. "She just told me there'd be two people and we'd need two rooms. Does . . . er . . . His Excellency need any special arrangements?"

I laughed in spite of myself. "No. Nor titles. 'Beldan' is fine. A fairly long bed would be nice, but he's quite adaptable. Right, Beldan?"

"I try," he said. Orlik's consternation made him a little uncomfortable, but I doubt that Orlik knew. Nobody else can read them the way I can.

"Good." Orlik looked relieved. He turned back to me. "Sandy, I know you're anxious to meet Pinocchio, but you must be tired after the trip. I think it would be better for you to wait until tomorrow, when you've had a night's sleep and a chance to go over some background material. You'll want to know some things about our facilities and what we've learned and how you should act before you go in."

I nodded vigorously. "I certainly will. I must admit I've been a little nervous about the whole prospect. I have lots of questions—"

He cut me off with a wave of his hand and an understanding smile. "Later. I'm going to give you some

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reading material—preprints and some notes we've written up for you—and some tapes to study in your room tonight." He looked at Beldan. "Beldan, are you going in to meet him too?"

Beldan nodded. "I'd very much like to."

"Then I'll have copies made up for you, too." Orlik turned back to me. "Go through this material tonight; it'll probably answer most of your questions. Any that it doesn't, ask me in the morning and I'll try to clear them up. Fair enough?"

"Couldn't ask for more."

He picked up a briefcase with my name tape-labeled on it and ushered us down the hall to a little room labeled OFFICE SERVICES. He handed the briefcase to a spectacled young man (who tried not to stare at Beldan) and told him, "We'll need copies of this right away, for Mrs. Turabian's companion." He turned back to us. "They'll be delivered to your rooms shortly. Supper when you call for it." I noticed he didn't ask if Beldan needed anything special—but then I'd told him Beldan was adaptable, and besides there's really only one kind of food to choose from now.

He took us to our rooms, a pair of cubicles with bed, dresser, and desk, sharing a small lounge area between them and a bath (such as it was) opening off that. The whole thing, he explained, had been created by partitioning up a former lab. It was a pity, he said, that work had shriveled so that labs had to be abandoned—but maybe it was just as well, since transportation outside had become so difficult that people had to live where they worked whenever possible.

Just before he left us, he looked at me and said earnestly, "I will give you one extra bit of advice right away. When you meet him, be casual and take your time. He'll have to get to know you before he wants to talk about anything as personal as what I want you to talk to him about. If you try to rush it, you might blow the whole thing. I'm sure you can understand that."

"I think I can," I said, a bit stiffly.

Do I ever!

He left. Beldan and I retired to our separate rooms, and that's where I am now. It's been a long day. I've been through most of the papers and tapes Dr. Orlik gave me, and I guess I ought to go through the rest. But I'm too tired, so I'll try to finish them first thing in the morning.

I want to be well rested then; I'm eager to get into this thing (though a little afraid, too). But I'm not too optimistic about how well I'm going to sleep. Unfamiliar quarters, and too much on my mind—Henry's problem about future plans and acceleration; my personal problems (which I must try very hard to keep separate); and my job here. I'm very serious about that.

It's not every day I get asked to try to save a species from extinction.

15/5, 3

My dreams were haunted by dol-

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phin distress calls—eerie pairs of shrill, sirenlike whistles, ascending sharply and then descending in a second or so—which I've never heard except on the tapes last night. I have to be careful not to let such things color my thinking.

I finished the tapes and books this morning; now on to reality. I put on my bathing suit before leaving my room, and threw a long shirt on over it. Then I went out to knock on Beldan's door. As expected, he came out in his usual long, flowing, multicolored and metallically iridescent robe. I was hardly surprised, but a little disappointed. We humans still don't know what the Kyyra look like, except for their red-eyed, hairless, noseless faces and their big two-thumbed hands, and we can't help being curious.

Dr. Orlik glanced at my bare legs and smiled when we walked into his office. "Well, I see you're all ready." He looked at Beldan. "How about you, Beldan? Are you going in the water?"

"I think," Beldan said carefully, "I'd rather just watch from the side, if you don't mind."

"Oh. Well, I suppose that'll be all right. You should understand, though, that they love physical contact and you'll win his trust faster if you get in and touch him and let him touch you."

"I'm aware of that, Dr. Orlik. But I'm afraid I would feel uncomfortable. I'm sorry."

"No matter. Pinocchio will understand, I think." He changed the subject. "Do you have any questions before we go in?" Beldan and I both shook our heads. "Good. Let's go." He stood up.

"No need to be afraid of him," Orlik said as he led us down the hall to an elevator. "He's big and powerful—and very gentle. Just treat him with ordinary respect and he'll return it."

We got into the elevator and started down. "I think you'll be surprised at how fast it goes. It used to take a long time to get a dolphin's trust, but that was because we couldn't get past all the barriers and actually talk to each other. Human and dolphin languages are mutually unpronounceable, for all practical purposes; we can't even hear most of what they say."

The elevator stopped and Orlik motioned us out ahead of him. "And the content and idea patterns are literally worlds apart. The everyday things that they and we talk about have little in common, and we organize the ideas very differently—for very good reasons. Pinocchio's language doesn't use words, and they find the fact that ours does amusingly strange and unnecessarily obscure."

We had already stopped in front of an unlabeled door and been standing there as he talked. He stared at the doorknob as he finished, "But with modern electronics that can render one mode of expression into a fair approximation of the other, the whole thing becomes much easier. You can talk to Pinocchio, he can talk to you, and suddenly the whole thing is on a

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much more civilized level." He looked up with a smile, as if he had just finished a well-rehearsed sales talk for an inspector from a grant foundation. (Quite likely, he had.) "Well," he said, as if he had just become aware of the fact, "we're here."

He opened the door (double, with an emergency airlock) and we followed him in—into a different world. At first glance the white walls and bright, even lighting reminded me of a handball court, but almost the whole floor was taken up by a square pool of clear, sparkling, dancing water. A dry ledge ran around three sides of it; the fourth lapped right up against a wall. The fourth wall, I noticed, looked different, as if it had been built at a different time from the others. And if I looked carefully along it, I could actually see the slight "tilt" of the water surface produced by the Earth's acceleration.

The air was damp and warm and full of a heavy fragrance reminiscent of both seashores and swimming pools. And at the far end of the tank, with the tip of its dorsal fin projecting above the surface, lay a magnificent animal, a sleek, steely-gray torpedo nine or ten feet long, with broad flukes at one end and a bulging forehead and slender beak at the other. The pool was only some twenty feet square and must have seemed pretty cramped to the dolphin, I thought. But I couldn't remember when I'd last seen so much water in one place. I could hardly wait to get in.

Before I could ask what I should do, Dr. Orlik gave a little whistle and cheerfully (but in an ordinary conversational tone), said, "Good morning, Pinocchio." Then he quickly grabbed my arm and pointed at a large screen hung at one end of the pool.

I tried to watch the screen, but my attention was divided. At that same instant, the dormant torpedo came suddenly alive, stirring, bending into a smooth curve and darting toward us. In the split second it took him to get here, the air filled with a rapid succession of what I might crudely describe as clicks and whistles.

And the screen lit up with words, in clear red letters, big enough to read from anywhere in the room:

GOOD MORNING, MASON.

FRIENDLINESS,
MODERATE
CHEERFULNESS.

IS THIS SANDY?

CURIOSITY,
EAGERNESS.
SONAR.

"Yes, it is, Pinocchio," said Orlik. "And she's very eager to meet you."

Pinocchio had stopped directly in front of me and raised his head out of the water, looking me over with big, surprisingly human eyes—and, presumably, ultrasonic pulses. Close up, I noticed that his otherwise smooth skin bore a goodly number of small scars and the hundred or so little teeth in his open beak were worn flat on the tips. He seemed to be grinning at me.

And suddenly I no longer needed to be told what to do. As usual, anticipation was more frightening than real-

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ity. I grinned back. It seemed the most natural thing in the world as I shucked off my shirt and stepped off the ledge into 80° water that lapped playfully at my legs somewhat above my knees. "Hi, Pinocchio," I said quietly. "I've heard a lot about you." I bent slightly to pat his bulging forehead, carefully avoiding his eyes and blowhole.

I heard a succession of strange underwater sounds, dolphinlike but coming from somewhere else, and then Pinocchio's blowhole wiggled and more sounds came from him. "And I've heard a lot about you," the screen told me he'd said.

He was nuzzling my legs, exploring them with his beak. It tickled, and I felt so gloriously good that I was only half listening to Mason's explanation. I knew most of it anyway. I did notice that he seemed a little surprised that I was already in the water. "There are microphones," he was saying, "to pick up dolphin sounds either underwater or in the air. The phonation apparatus in his blowhole is divided and he can use the two halves singly, simultaneously, or independently. Our computer's in the next room, beyond the screen. The first two columns of the display give a very free verbal translation of what he's saying, or both messages if he says two things at once. Some of the sounds carry connotations to compensate for the lack of an expressive face, and the third column has comments about those. When you say something, it generates an approximate translation into his terms and plays it through underwater speakers for him. Only approximate, of course, and it can't handle everything . . ."

More words from Mason; more clicks and whistles from Pinocchio. He slapped the water with his tail, splashing me, and started swimming around me in tight circles, rubbing his smooth sides against my legs and nudging me toward the center of the pool. Beldan watched us with obvious fascination. The screen said Pinocchio was excited and pleased and had told me, "It's been too long since I had anybody new to play with."

I laughed. "Me, too." Faint dolphin noises from the underwater speakers, then more from Pinocchio, and new words on the screen.

"Come on!" Pinocchio told me (with "playfulness"). "Get wet!" And before I finished reading it, he startled me by whirling about and slapping my calves with the side of his tail, almost but not quite hard enough to throw me off balance. For a split second I struggled to stay standing, briefly afraid, then realized his intent and let myself fall laughing into the water. He could have killed me with that tail, if he'd wanted to—so he obviously hadn't. I relaxed and let myself go completely under and come up with my hair dripping. It felt as heavenly as I'd anticipated.

Pinocchio was nuzzling the parts of me he hadn't been able to get at before. I ran my hands over all of him I could reach. The thought crossed my mind that Mason must have given me quite a buildup—and Pinocchio must

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trust him very deeply—for Pinocchio to take so quickly to me.

I had finished struggling into a sitting position before I realized that Pinocchio had helped. Now he was slithering across my lap and coming to rest there. He twittered. "Rub me between the flippers." I did, and the screen showed, "Ah-h-h!" with no further comment. I laughed, both at Pinocchio's reaction and at the way Mason had programmed the translator.

With another of his mercurial changes, Pinocchio darted away from me and over to the side of the pool. He stopped directly in front of Beldan, looking up at him as he had looked up at me. "And who is this?" he asked.

Mason smiled down at him. "I've brought you a surprise, Pinocchio. This is Beldan, one of the nonhumans from off Earth that Sandy talks to. She brought him with her."

"Fascinating," said Pinocchio. "I'm glad to meet you, Beldan."

"And I'm glad to meet you," Beldan said slowly. "I'm not sure what to say to you . . ."

Pinocchio laughed, according to the screen. "Then don't say anything," he suggested, "until you have something you want to say." *(An admirably simple and sensible idea,* I thought. *Wonder why it so seldom occurs to people . . .)* "You're coming in, aren't you?"

Mason, apparently satisfied that all necessary ice was broken, quietly opened the door and slipped out. Beldan's big red eyes jerked slightly back in their sockets, then forward. "I'm afraid not," he told Pinocchio. "I'd love to join you, but I'm not a water animal."

For a very brief moment, Pinocchio was almost silent. There was one brief burst of noise, soft and cut off abruptly, as if it wasn't meant for us and he decided after he started that he didn't really want to say it at all. The translator screen indicated DISTRUST(?) SUSPICION(?). His face, as Mason said, gave no more clue to what he was thinking or feeling than a mask. But after a tiny pause he said lightly, "Sandy's not a water animal either. But she came in with me." He swam once around me, rubbing his side against my back, and went back to Beldan. "Are you afraid of me?"

"No," said Beldan. "Please don't think that. But I can't come in the water. I'm sorry."

Pinocchio swam slowly back to me and cradled his head in my lap. "Why is he afraid of me?" he asked, perplexed and a little hurt. "Or is it that he—"

He broke off abruptly, listening. Beldan had taken out his music-pipe and was playing one of his haunting improvisations. For a moment Pinocchio listened and scanned Beldan with eyes and echoes. Beldan kept playing. After an uncertain few seconds, Pinocchio came back to me. "What's he doing?"

"Why don't you ask him?" I suggested, stroking him. "I think you've upset him by making him think he's hurt your feelings. But he didn't want

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to do that. He's just even less of a water animal than I am. You wouldn't want somebody to make you get out of the water, would you?" He lay silent and motionless—thinking, I suppose. "But why don't you ask Beldan?"

"OK." And he was off, back to Beldan. "Beldan, what are you doing?"

Beldan stopped playing but didn't put the pipe away. "What Sandy told you," he said. "She's a very perceptive young lady, Pinocchio. We Kyyra often play tunes on these pipes when we're agitated." He paused, with obvious hesitation, then knelt down at the pool's edge and held the pipe out to Pinocchio. "Would you like to look at it?"

I was impressed by the gesture—I knew what his pipe meant to Beldan or any other Kyyra. But Pinocchio just looked quickly, touched it once lightly with his beak, and drew away.

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"No, but thanks," he said. "I'm not good with tools. I might break it. I'm sorry if I made you agitated. I've gotten in the habit of mistrusting humans who say they want to meet me but refuse to come in the water. You look so much more like a human than a dolphin that I guess I thought of you that way. But you're not human, are you?"

"No," said Beldan.

"Then I must learn to think of you as what you are, instead. Please be patient with me." He paused, but he talked so fast that the pause was barely noticeable to human ears. " 'Tunes,' you say. What are these tunes, and how do they help when you're agitated?"

Touché, I thought. *One of those questions that sounds simple—and is really so profound you can talk about it for hours and never really answer it.*

"That's hard to explain," said Beldan, warming to Pinocchio and the subject with a human smile. "The tunes are patterns of sound that express our feelings and can alter them—"

"Are they elements of your language?"

Beldan thought it over, and I remembered the time he had told me about their "musical puns" when I visited their convoy ship right before they started moving the Earth. "No," he said slowly, "though there can be very close relationships. We make the tunes up—"

"Ah," said Pinocchio, with the excitement of dawning light, "then they are something like our [*untranslatable*]."

"Your what?"

"Our [*untranslatable*]. It's hard to explain. Dolphins have a large body of traditions, of sequences of sound that we tell each other from one generation to another. Some are simple patterns of sound that tell no tales, but we find them enjoyable. Others tell stories of things that happened long ago, or things we need to remember. Still others tell stories of things that never really happened. The distinction is not clear-cut; a good bard always improves on the compositions he repeats—except the unchangeables." He paused, again briefly. I marveled at how rapidly he said things which, in translation, were long and complex. I had to read like lightning to keep up with him.

He was speaking again, to Beldan. "From what you say, I suspect the connection between your tunes and language is not as intimate as ours. Does your language consist of words, like human speech?"

"Yes—," said Beldan.

And I saw a chance to get back into the conversation. "Mason said yours doesn't," I said, splashing over to sit on the bottom next to Pinocchio. "What did he mean, exactly?"

"I'm not sure I understand the 'word' concept well enough to give you a good answer," Pinocchio said with mild amusement. "But I gather a word is a little sound-symbol which is always the same and represents a

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primitive idea-element, and you string them together like beads or building blocks. We do rather little of that. Our language, we suspect, grew out of descriptions, and our descriptions are much more graphic than yours must be. You might say we talk in pictures."

"Example?"

"Not easy. Suppose I say—" The screen showed, " 'A fish just swam by above and to my right.' Mason tried to tell me how that came across on your translator, and it wasn't easy—and not much got across. Our world is primarily a world of sound, and we do a lot more with it than humans do—and our perceptions and communications are much closer. If there were really a fish here—don't I wish!—to see it I'd make certain noises and listen to the echoes. What I really said was, 'I made such-and-such kind of feeling noises, and this is what I heard.' Another dolphin, when I repeated my echoes, would literally see that fish—what kind it was, how big it was, where it was, how fast it was going, what was around it. . . . Does that help?"

I nodded, trying to visualize something of his world, wishing I could see it too. "I think so." *To think that we've been sharing the planet with something like this for all this time and never realized it until now—when it's almost too late.*

Maybe more than almost . . .

"Do humans have tunes?" Pinocchio asked me.

"Yes," I said, thinking of how simple, how primitive human ideas of tunes must seem to a dolphin. Again I remembered myself back on the Kyyra starship, eating and drinking with Beldan in a room filled with his kind, talking of our languages and musics. And the other experiences we'd shared with sound communication . . . "With us," I told Pinocchio, "the line between music and speech is even sharper than with Beldan's people. But we do have some things you might be interested in hearing." Abruptly, belatedly, I was surprised. "Hasn't anybody played any human music for you?"

"Not that I recall."

"Well, I'll have to see if I can't fix that. Meanwhile . . ."

And so it went, for several hours. Three of us, of three species, chatting with animation, eagerly comparing notes on differences and similarities among our three very—but not hopelessly—alien cultures. Gradually I began to know Pinocchio, to like him, to admire him as a remarkable individual who was equally a playful child and a philosopher of wide-ranging interests and wisdom. For one exhilarating day, the three of us got so wrapped up in learning about each other that we could forget the more painful aspects of the circumstances that had brought us together.

But when the afternoon was over, I had to remember again—and it was that much more painful then.

Beldan and I had dinner with Mason in his apartment (which, like ours, is a hastily converted corner of a

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former lab). The quarters were cramped and the food the same wretched fare we have at home—a handful of slightly different forms of thinly disguised essence of algae from mass-produced recycling plants. Hardly surprising, of course, but a little disappointing anyway. I think a part of me had subconsciously dared hope that in a special, exotic place like this food would be special and exotic too.

Well, I'll get used to it. I'm going to have plenty of time to practice. Still, once in a while I can't help wistfully imagining a real lobster or hamburger or steaming ear of corn dripping with butter . . .

And this is clambake country.

Mason made a valiant effort to play the gracious host, making sure his guests were comfortable and well-fed and lubricated with small talk before getting down to business.

(Small talk is a lost art these days. What do you talk about? The weather? Nobody sees it; nobody cares about it. Sports? There aren't any. With the struggle we had just keeping this many of us alive this long, there was no time or energy to spend on football stadiums or hockey arenas. How bored and miserable you are? Everybody else is too, and for the same reason, and they were the same last week and they'll be the same next week.)

Anyway, Mason tried. I guess the liveliest topic we came up with was his curiosity about Beldan's food converter, the gourdlike gadget he carries to produce an antidote to poisonous ingredients in alien food. If that was the peak, you can imagine the valleys. After a while the effort to force innocuous conversation grew so obviously strained that I jumped into a lull with what we all really wanted to talk about. "Pinocchio," I blurted out, "is quite a guy, isn't he?"

I think Mason was relieved. "Yes," he sighed. "You enjoyed your visit with him?"

"Immensely. But one thing puzzled me. He isn't . . . the last, is he? The reason you asked me to come—"

Mason looked a little surprised. "He didn't tell you about Topsy and Turvy?"

"No."

"Two females who came back with Pinocchio the last time." He looked thoughtful, as if trying to remember how much he'd told me. "You remember that when I wheedled the administration here into building this lab, the central idea was that dolphins should be free to come and go. They did, and it's a good thing because Pinocchio wasn't one of the originals and we could never have made the real breakthroughs without him. He heard enough stories about us from other dolphins to convince him we were intelligent, and he was interested enough to make a big personal effort to communicate. So he learned all he could from the others about the crude communication they'd achieved, and then he came here, on his own initiative, and showed us how to build on it. That was only about three years be-

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fore the launch. When the Earth started moving, he was off somewhere, but he quickly saw that the oceans were being destroyed and everything that lived in them was in mortal danger. None of them understood why, but Pinocchio guessed that we might know something about what was happening and we might be able to provide a refuge. A lot of the dolphins were as afraid of coming here as they were of what was happening in the oceans. But he convinced a few of them that staying was sure death while coming to us was a long-shot chance for survival. Those few came with him. It was a harrowing trip—get him to tell you the story sometime. But Pinocchio and Topsy and Turvy made it, and we got them into an indoor tank—had to seal off the outside connection, of course. And then we got to start trying to tell them what had happened, and why." He emitted a dry chuckle. "Don't think that was easy. Their picture of the world doesn't include much detail about things outside the water. To them, the stars were just lights in the sky, and the sky was something very peripheral and unimportant that they glimpsed when they jumped at night. So you can imagine—faintly—how much background, and what utterly alien background, we had to give them before we could tell them the galaxy had exploded and we were trying to ride the Earth to a new one to save our skins."

"But not theirs." I pondered silently. Beldan didn't say anything, but he did start playing something very slow on his pipe. Finally I said, "And now they—"

Mason nodded. "As far as anybody knows, they're the last three bottlenose dolphins alive."

I didn't feel like eating any more. I said, "But I only saw Pinocchio. Where are the others? Can I meet them?"

Mason shook his head. "Sorry. They're here, in this building, but I doubt that you'll be able to meet them. They were never here before Pinocchio brought them, and they've had a rough adjustment. Dolphins have always been hard to keep in captivity, and Topsy and Turvy's circumstances are especially unfortunate. Contact with humans upsets them, so we try to minimize it. They don't take well to the synthetic food we have to give them, since the fish are all gone. And . . . Topsy hasn't been feeling well. She's always tended to be a bit sickly. I worry about her a lot . . . especially now."

Beldan was still playing his pipe, and I knew he was unlikely to join the conversation—though I also knew he would listen intently to every word. I said, "Is that why they're separated from Pinocchio?"

"No . . . though if she comes down with anything, it might be a good idea. The separation was Pinocchio's idea. That's what I want you to talk him out of."

Finally. Mason had told me, in very general terms, why he wanted me to come to Woods Hole. But he'd been

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vague about details. Maybe now I would finally find out exactly why he thought he needed me—and what he thought I could do.

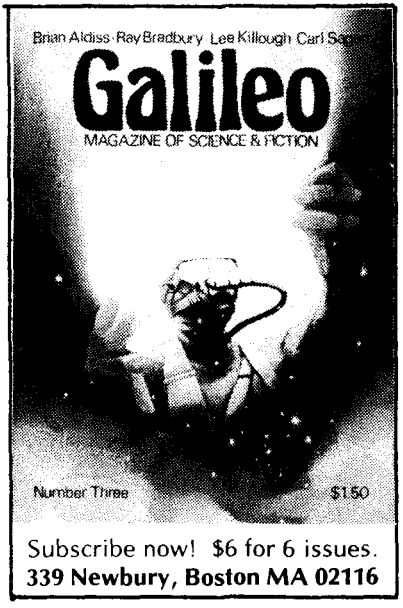
I waited. Finally he said slowly, "Dolphins play a lot; it's a very pervasive, integral part of their whole way of life. And a lot of the play is very uninhibitedly sexual. With no technology, abstinence is the only form of birth control they have available. So Pinocchio decided they'd better not play—and that meant they'd better live apart."

I still didn't understand. At all. I frowned, momentarily sidestepping the main issue, hoping it would clarify itself. "You mean there are three of them here, and Pinocchio deliberately cut himself off from all contact with the others?"

"Not all contact. Just physical. They talk, but they don't touch. Because if they do, sooner or later one or both of them will get pregnant. And Pinocchio doesn't want that to happen."

Nothing had clarified itself. "But that's what they need! Birth control is the last thing in the world you need when there are only three members of a species left. It doesn't make sense."

"I agree. Pinocchio doesn't." Mason frowned, picked his words carefully. "When he heard our story, he got depressed—not even angry, mind you, but depressed—and he gave it a lot of thought. He decided that living conditions here were just too alien, too restrictive for dolphins. *He* could stand it—he doesn't want to die, and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once he made his decision he even became reasonably cheerful again. But he decided it would be unkind to produce new calves who would have to spend their entire lives cooped up in tanks, with no prospect of an end in sight. And I haven't been able to budge him."

I thought about it for quite a while before I answered. Pinocchio—through Mason—had struck a nerve, a currently very active and responsive storm center in my own thoughts and feelings. "I'm not sure he's wrong," I said finally, with careful restraint. "But he's too nice to become extinct. If he's typical—"

Mason laughed. "I wouldn't say typical, exactly. He's plenty special—but only in having typical traits highly

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developed. Like an Einstein or a Schweitzer among us. He's unusually capable, and he's the oldest one we've ever worked with."

I nodded, but wondered about one thing. "Old, you say. Does that matter, as far as—"

Mason shook his head with a slight grin. "Nope. Old dolphins never quit."

Now, sitting here finishing off today's entry, I find myself thinking about Jonel. I ought to call him. But not yet, not tonight. I still haven't sorted myself out.

I do find myself thinking about the similarities in our situation and the dolphins'. But it isn't really the same.

Is it?

16/5, 3

I dreamed about a recognizable incident from my past—something I don't often remember doing. But this was one I'd dreamed about before. It was the day I first realized the dolphins were going to be in trouble if we decided to accept the Kyyra offer, a gray, windy day, too cold for Florida even in December. Beldan was with me—this was in the days when the politicians were still arguing and I was becoming his only human friend. We stood together by an inlet near the spaceport, watching dolphins or porpoises playing in the water. I told Beldan they were intelligent, and he admitted he didn't know what could be done about them. I think it bothered him as much as me.

I don't even know what species they were; I didn't know much about them then. But in my dream one of them was Pinocchio, and two were Topsy and Turvy.

I moved slowly when I got up, trying to think about the few things I could do. I'd promised Pinocchio I'd show him some human music; it seemed hard to believe nobody had. Music—sound patterns shaped by intelligence and culture—would seem one of the most likely areas of shared interest for humans and dolphins.

And Kyyra.

Not that I believe in trite nonsense about music being a universal language, of course. The first time Beldan and I managed to improvise a duet on his pipe and my oboe, I was flabbergasted at how much we'd achieved in a very subtle kind of communication. But, difficulties notwithstanding, such things are an important part of both our lives and we've learned a lot about each other by comparing notes on them.

I couldn't resist the temptation to make it a three-way comparison. I took Pinocchio a recording of the same symphony I'd tried on Beldan the first time Jonel and I had him over.

Pinocchio was intrigued. He lay quietly in one spot for most of it, but once in a while he would stir slightly or even dart around the pool and slap his tail on the surface or make untranslatable pronouncements as if reacting to the music. *How* he was reacting, what he felt, I could only guess.

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I had explained to him beforehand that the sounds were made by many humans using artificial instruments in a consciously coordinated way. Like Beldan, he found the ensemble idea novel; unlike Beldan, he was equally unfamiliar with the use of instruments.

When it was over, he lay beside me and began vocalizing loudly. The translator showed that he was pleased and excited, but also curious and puzzled. "I enjoyed it," he said. "Of course, there was a lot I didn't understand . . ."

"Not surprising," I assured him. "After all, it's as new to you as your speech is to me. But you did find enough in it to like?"

"Oh, yes. Though of course it seemed rather empty in the ranges that we can hear and you can't."

And vice versa, I thought with faint amusement, but I didn't say it. I saw another chance. I asked quietly, "Do you think Topsy and Turvy would like it?"

I was unprepared for the sharp annoyance the screen showed with his "words". "What do you know about them?" he demanded. "How do you know about them?"

But I stayed cool—reasonably, anyway. *May have been a mistake,* I noted. *But I had to start somewhere.*

"Mason mentioned them," I said, trying not to say more than I had to. I knew I mustn't lead Pinocchio to think Mason had put me up to pressuring him. "He said they'd come here with you and were in another tank. I'd like to meet them too, but Mason said I probably won't be able to. So I have to ask you about them." I paused uncertainly. "I'm a little surprised you're not with them. I would have thought you'd want to be together."

He hesitated too—a long, long time, for him. "Do you know what would happen then?"

"I think so," I said. "What's so bad about that?"

Another lengthy silence. "Is this any life for a young dolphin? It's too bad you can't talk to Topsy and Turvy. They're relatively young, and they're not holding up even as well as I am. The three of us are already here; we have to hold up. But we don't have to inflict this on lives which haven't yet begun."

"But it's not going to always be like this," I told him (a little hollowly, I admitted to myself). "This is just to get somewhere else. We'll move into a new world, with open skies and seas—"

"Where is this new world?" Pinocchio asked suddenly.

The question caught me off guard. "I don't know, exactly," I said. "In M31—"

"Have you seen it?"

"No. But—"

"Do you really believe you will ever see it?"

The question hurt far more than it should have. I'd known the answer for a long time. But sometimes you can stare at something for a long time before you suddenly really see it, and then it's blinding. "No," I said very

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quietly. I looked down at the dancing wavelets and then closed my eyes. "*I* won't. The trip will take much longer than I will live, at the rate we're going now. But the kind of world we need is common enough. There'll be one out there, for our descendants."

"Maybe." CYNICAL LAUGHTER, the screen said. It ill-became him.

"It will," I insisted, reaching out to stroke his back. "And if you and Topsy and Turvy don't get together, there'll be no dolphins to enjoy it."

"Maybe that's just as well," he said, with surprising calm. "Maybe it's best."

"But how can you think that? It's hard for a while, but don't you want something better for your descendants? Not your children, of course, but later . . ."

"If we don't have any descendants," said Pinocchio, "it doesn't matter, does it? I can see you don't understand. Dolphins and humans see future and past differently. We have traditions from our past, and we provide for our immediate offspring's well-being. *Their* offspring are their concern. And where there is conflict . . . Let me explain it this way. You say I should father children so that maybe their children's children can have a good life. All I see is that my own will not, and the farther future is uncertain. I have no right to produce lives which will only be used as an instrument for the benefit of others who may never even exist."

I struggled to get hold of it. A view that reflected an alien outlook, but I could see and respect it. "But," I said, making one final weak effort, "don't dolphins have an instinct for preservation of the species?"

"The value of intelligence," said Pinocchio, "is that it can overrule instinct when instinct is wrong."

I could think of no reply to that. We all sat silent for a minute or so, with no sound except the water lapping around us and the air and water circulation systems humming softly in the walls. Wordlessly, I rubbed Pinocchio between the flippers; he rolled on his side and drifted slightly closer to me. Finally I said, very softly, "Pinocchio, do you hate us for what we've done? Humans, or Kyyra, or both?" *I would,* I thought.

But the screen showed no hatred in his answer. Instead, almost embarrassingly, it showed gentle reassurance, and he nuzzled my side. "I can't hate you for what others have done, Sandy. And I can't blame them for doing what they did to save their own kind. In their position, I suppose I would have done the same. But I had no opportunity, and things have come out against us. Unfortunate, but there's nothing to be done."

I think I felt a tear on my cheek.

After that, we led each other away from such highly charged topics and back into tamer conversation. Beldan got back into it, and we talked all day, missing lunch.

Mason was tied up with some urgent business at suppertime, so he

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didn't eat with Beldan and me. He had our dinner sent to us, and we ate it together at the table in the little lounge between our bedrooms. We didn't talk much as we ate; I was busy composing myself and I think Beldan was too. But by the time we finished, I found that I was ready to talk—or at least I didn't want Beldan to go off to his room and leave me alone.

I looked at him and said, "You know, Beldan, in ways they're more like you than us."

He looked at me uncertainly as he tucked his food converter back inside his robe. "You mean in the relationship between various uses of sound that we were discussing yesterday? Yes, I suppose so."

"No," I said, "I mean a lot more than that. Things about their whole outlook. Social relationships, for instance. Except when we're talking about certain things—like what's happening to them—I have the feeling you find Pinocchio more congenial than most humans."

"That's true. Of course, I also find you more congenial than most humans."

I shrugged. "Well, from what I've read and seen and heard, I think dolphins have some characteristics in common with Kyyra. When you first came to Earth, you said you were bothered by the prevalence of suspicion and distrust and deceit among humans. Remember?"

"I remember." I could see that the question disturbed him because it made him remember a lot more than that. It reminded him that the Coordinator—the huge telepathic computer that continually molds everything on his planet and its convoy ships, including individual minds, into a harmoniously functioning whole—is dying. He almost reached for his pipe, for solace, but successfully resisted—as if preparing himself for the day when he must get along without even the memory of the Coordinator.

"Well," I said, "It seems to me they're like you that way. But they don't have a Coordinator. Do you suppose their openness comes from the fact that their bodies are largely transparent to the sound waves they use for sensing?"

"It sounds possible," Beldan said thoughtfully. "I suppose if your visceral reactions are obvious to everybody, you don't waste much time trying to lie."

I must ask Pinocchio.

17/5, 3

I asked Pinocchio about that matter of the transparency of their bodies and the openness of their dealings with each other and with us. He suspects I'm right, but he never thought about it before; the whole thing is so much a part of them that they've always just taken it for granted. We talked quite a while about that, and how things look to him, and how the Coordinator has had a somewhat similar effect on the Kyyra, and how humans—neither telepathic nor controlled nor transparent—have made various sorts of devious-

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ness a pervasive part of our cultures.

Pinocchio found that amusing ("It must make life awfully complicated," he mused), and we all found the whole subject quite interesting. But otherwise it was a relatively unproductive morning. Pinocchio just wasn't as talkative as usual. I have a hunch (though the translator gave me nothing concrete to support it) that some of the things I said to him yesterday have him a bit rattled.

Well, that's fair enough. Some of the things he said to me have me a bit rattled.

We quit early and Beldan and I met Mason for lunch. I told him about my hunch, that Pinocchio was giving my remarks more thought than he yet chose to admit. He nodded but didn't quite smile. "Could be a hopeful sign," he said. "Maybe." He put down his fork and dabbed at his mouth with the corner of a napkin. "On the off chance that it is," he said slowly, stretching, "I guess now would be a good time to tell you the other reason I asked you to come."

I waited without comment. I'd half-expected this since I first met him. (Human deviousness, again—he tells Pinocchio one reason for my coming, me another, and now that I'm here he tells me still another. Well, I'm human too. I'm not surprised.)

"Suppose you succeed," Mason began, "and they do start a family. Where will we put them? Obviously we can't turn them loose in the sea; they'll have to stay in tanks like we have here. The ones we have could take the added load of a calf or two while they're young, but only while they're young. If they survive, we're going to need more tank space."

He paused. His eyes took on a distant expression, his voice a hint of deliberately suppressed anger. "This place has never really accepted me, you know. When I came here as a young man, the administration was so conservative I couldn't even tell them what I really wanted to do. To get even this facility, I had to justify my proposal in terms of things like EEG studies of wild dolphins and possibilities of training them to help us in field research. Flunkeys—like grad students. Then, gradually, I could let my important findings emerge as 'accidental' by-products."

I was embarrassed. He might have some legitimate complaints, but his attitude seemed to smack unnecessarily of sour grapes. " 'Even this facility,' you say," I said. "Isn't this a good facility?"

"It was acceptable," he conceded, "when the tanks were open to the sea and the dolphins just came in for visits. But they're much too small for permanent confinement." He shrugged. "Well, none of us are living in luxury these days, and they're intelligent enough to understand that. But there are limits. We're at rock bottom now, for the dolphins we have. If we get more, we're absolutely going to need more space. And my fearless leaders keep making threatening noises about closing down even what we have."

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"You can't be serious," I said, genuinely shocked. "How can they even consider—"

"Expense," he said with a sardonic smile. "We don't measure it in money any more, but it's still very much a factor. In terms of materials and effort, even rock-bottom dolphin facilities aren't cheap to build or maintain. They have to be big. We have to constantly circulate and treat the water and air; temperature and chemistry are critical. We have to feed them. I'd like to give them fifteen or twenty pounds of butterfish a day, but we have to make do with equivalent amounts of synthetics. And the form of the synthetics is more critical than for humans."

"But surely," I said, "we owe them at least that."

"I think so," Mason nodded. "And I hoped that if you called the matter to Henry Clark's attention, he would agree strongly enough to see that we do get what we need."

So that was it. As if Henry doesn't have enough on his mind. He was so appalled at the destruction and loss of life in building the acceleration up to its present level—largely because it had to be done hastily—that he's very determined to give plenty of thought to what we do next. For the first time, we can afford some time to think, and Henry's declared a one-year moratorium on most preparations for the rest of the trip. A lot of people think that means he has a lot of free time, but it doesn't—not by a long shot. So far the effects of either going to a very high acceleration or changing the acceleration very often look so terrifying that we're all very doubtful that we'll do it that way—but we (and especially Henry) are very busy checking all the angles we can on all possibilities. We want to be sure. "He's terribly overworked," I said.

"But surely, if he knows it's literally a matter of life or death for another species of intelligent and civilized natives of Earth—"

I nodded. "Oh, yes. He's already interested. When he really understands the situation, he may even be able to do something. If Pinocchio decides to have a family."

Mason appeared to relax a little, as if satisfied that he had done all he could for now. "Good enough," he said. "So I guess we have to solve that one first." With a smile, he tried to shift back to small talk. "Tell me, do you and Jonel have a family?"

"No," I said—rather curtly, I'm afraid. I almost added, "Not yet," but it didn't feel quite necessary, so I left it at that.

I don't think I wanted to talk about it.

And now Orlik has really complicated things. I'd been looking forward to spending the afternoon relaxing, thinking, coming to terms with myself, getting back in tune with Jonel. And maybe coming up with some new angle on Henry's acceleration problem, or even how to get through to Pinocchio.

And now Mason's given me something else to think about.

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18/5, 3

Pinocchio caught me completely off guard today. Thinking back, I wonder if Mason was reading me better than I realized yesterday, and talked to Pinocchio alone sometime after lunch. Or maybe it was just coincidence . . .

One thing kept disturbing me about Pinocchio's attitude toward all this. I didn't know how to broach it, but I kept it in the back of my mind, waiting.

It seemed to me that he was in a bit of a mischievous humor when Beldan and I went in. There was nothing about it on the screen, but I think I'm learning to tell a lot more about his mood than the translator tells me.

He was more interested in playing than talking when I first got in—going limp and having me push him around, then expecting me to do the same so he could push me around. I cooperated, enjoyed it, and got tired before he did. But he sensed when that happened and suggested, "Let's rest."

I sat down on the bottom, slouched down so the water could lap at my chin, and he hovered in the water beside me. Our play had been so completely nonintellectual that I found myself sitting there trying to think of something to start a conversation with. There was one thing I was sure I didn't want to use . . .

And then I remembered something Mason had said. "Pinocchio," I said, rubbing his back lightly, "Mason said I should ask you to tell me about your trip here."

"I prefer not to talk about it," he said. "But I think I should . . . because I care what you think, and I sense that you think we've quit too easily, that we've given up without a real struggle." It was as if he'd read my mind. That was exactly what had been bothering me. Despite what both he and Mason had told me, there was the nagging feeling that the dolphins had not done all they could.

For a moment the first two columns on the screen were blank while the third showed little flickers of agitation. "I was south," he said finally. "Down the coast. I don't know how to tell you exactly where, but it doesn't matter. It was a goodly distance. The first indications we had of something wrong were the quivers, the little shock waves in the water that told us the bottom was shaking. And then the currents, the tug of something trying to pull us and everything else south. We couldn't see the sunlight fading yet; that was too slow. But we felt the currents and the tremors and saw our food being swept away from us. We followed it for a while, and when the while became too long and it showed no signs of slowing, we began to realize something was very wrong. Then we noticed that the bottom was warming in a way it had never done before. Gradually we began to feel fear—not the fear we feel when we meet a shark, which is deadly but we know how it is deadly, but the far worse fear of something unseen and unknown. Worse yet, it was a fear that grew slowly, because it took time

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to be sure something was happening. At first we argued about it; by the time most of us realized the extent of the danger, we had drifted quite far to the south. And we knew nothing to do.

"I thought of Mason. I'd been here before; I liked and trusted him; I knew humans understood some things we didn't. And I knew there were shelters here. I persuaded a dozen of my fellows to come back with me. Many more would not; the prospect of placing their lives in human hands was too unfamiliar, too terrifying. We hated to leave them—there were many dear friends/relatives—but we decided it was best that some of us go and some stay. That way at least some of us might survive. In those days, Sandy, we were very concerned about saving our kind.

"Thirteen of us started—upstream. It was very far; it was hard swimming against the current; it was hard to navigate because so much was changed. Food was scarce; by the time we started, too much had been swept away or destroyed. We swam without stopping for several days, pushing ourselves hard. Eight of us—including four of my sons and daughters—died of exhaustion or hunger. Two more were battered to death in storms. Only Topsy and Turvy and I remained. Each of us was too tired and hungry to feel like continuing, but we prodded each other on. We passed landmarks I knew; I knew we still had hours to go. But only hours, now; somehow, we could make it. But the water was getting shallower . . .

"And then it stopped. Miles before it should have ended, miles before this place, we were at the foot of a beach, struggling not to run aground, and there was nowhere else to go. I think that was when we lost hope, and we never got it all back. We lay there in the shallows, in the dark, huddled together, feebly crying our distress to a sea that no longer had anyone to hear us.

"To our astonishment, someone did, but it wasn't a dolphin. It was a ship full of humans from here, roaming the sea, hoping to find survivors like us. They followed our calls, picked us up, carried us back here. We vaguely remember what you would call a nightmare—though we don't dream as you do—a nightmare series of slings and hands and tiny tanks and long rides. Mason said the longest ride was in something that flew through the sky and made a continuous nerve-wracking noise. And then we were here, and they fed us things that weren't fish and tasted terrible but were better than nothing. And Mason told us what happened. We could only partly grasp it, but we grasped enough to know that there was nowhere else for us to go, nothing else for us to do.

"You think we didn't struggle, Sandy? How many of you have ever struggled as we did? But there comes a time when all the struggle is used up, and there's barely enough energy left to live out your own days with a minimum of pain. That's where we

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are, Sandy. If there were more of us, or conditions were much better, or there was any hope of their getting that way . . ."

"Suppose we could get bigger tanks," I said. "Much bigger—"

"Still just tanks," he said curtly. "You can't give our ocean back. No, we've fought all we can. Or choose to."

I understood that. I still wasn't satisfied, but I understood a lot better now. I'd felt the same way myself on more than one occasion—and never with a tenth as much cause. I sat there trying futilely to think of something to say.

And that was when he caught me. Abruptly, the mood column on the screen changed to lighter things and Pinocchio said, "But this is depressing; let's talk about something else. I'll have no more children, but I'd love to hear about yours. How many do you have?"

The question hit me like a bombshell. It was so simple, so obviously related to things we had talked about, that I should have anticipated it. But I hadn't. And now I was afraid he would see me as a hypocrite when he heard the answer.

But I couldn't lie to him. "None," I said softly.

He didn't answer right away. From a human, I would have considered any further pursuit of the question plain, nosy rudeness, and wouldn't have hesitated to tell him so. From Pinocchio, I couldn't consider it that. It was I who had first raised the subject. He had fully as much right to ask me such questions as I did to ask them of him. But he waited as if uncertain whether he should continue. Finally, with the third column showing gentleness and reluctance to pry, he said, "I don't understand. You have no mate?"

"Oh, yes," I said. "A very nice one. His name is Jonel."

"And you live with him?"

"Yes."

"And you play together?"

"Yes. And work . . ." I toyed briefly with trying to explain some of the differences between human and dolphin work and play, but quickly decided they were much too complex and subtle.

And, of course, that wasn't what he was driving at, anyway.

"Then I don't understand," Pinocchio was saying. "How can you not—"

"For humans," I said, "playing together doesn't necessarily lead to babies. We have ways of preventing it. We have babies only when we want to. But if we don't want to, we don't have to hide from each other."

"Interesting," said Pinocchio, the third column blank. " 'Ways?' "

"Technological ways. Mason can tell you about them."

"Hm-m-m." He pondered. "It sounds unnatural to me. I don't think I'd like it." I felt a tiny flare of anger, thought, *As unnatural as locking yourself away from Topsy and Turvy seems to me?* But he didn't give me time to waste much energy on that. He said, with a sonic equivalent of a

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shrug, "But that doesn't matter. Our backgrounds are different. What does puzzle me is why you've chosen to do it this way."

I think I blushed; I know I felt very uncomfortable, very aware that the conversation had gotten completely out of my control—and onto ground where I was more sensitive than I liked to admit, even to myself. And especially to Pinocchio.

"Jonel and I," I said lamely, "think it would be better for us to wait a while and see how things develop." (*No,* I corrected myself sternly, *let's be honest. I think that. Jonel has been anxious to start a family for quite a while now. I'm the one who's been stalling. And hating myself for it, just like the day we got married . . .)*

We hadn't planned to do it that day; we hadn't even thought much about setting a date yet. But I'd just sat in on my first meeting with the Kyyra, shortly after they came to Earth. Jonel had already told me about the core explosion; now, when I heard Beldan and Henry and Chandragupta Rao talking about what it would mean if we accepted their offer to move the Earth, I was scared. I was scared as I had never been before, and confused and helpless. And since I wasn't used to feeling that way, the fact that I did was scary in itself. Jonel and I went out to the beach and decided to get married right away; and I kept saying things that didn't sound like me about how maybe it would be better not to have the children we had always planned.

That passed quickly, but lately, with things settled down to what Rao called "spaceship-style living," I find myself feeling some of the same doubts again. With the isolation, the monotony, the dependence on all those umbilical cords, the epidemic depression—and no end in sight—I just don't feel like becoming a mother. Eventually, I keep telling myself, but not now. Not just yet.

Jonel's been telling me it's more important than ever that people like us have children now, and throw everything into raising them well. Intellectually, I still agree with him. But I want it to *feel* right . . .

All those thoughts raced around in my brain as I sat there in the pool trying to think how to explain my feelings to Pinocchio. They were interrupted, to my surprise and annoyance, by a series of loud noises that sounded remarkably like human laughter.

And the translator said they *were* laughter.

"What's funny?" I snapped.

"The irony," said Pinocchio. "Your situation is just like mine, and yet you've come all this distance to try to get me to change my mind. Perhaps I should turn the tables and try to change yours."

"But it's not the same," I protested. "Similar, but there's a very important difference. There are lots of humans, but only three of you."

"Hm-m-m," said Pinocchio, again with mild amusement. "Makes your

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problems sound pretty trivial compared to ours, doesn't it?"

"You twist everything I say," I complained, annoyed because of that (and even more annoyed because he was right). "Yes, in a sense, that's true. But what I meant is that what you decide determines the whole future of dolphins. But there are so many humans that what Jonel and I decide doesn't matter."

"Ah, but how many of those humans feel the same way you do? If it's too many, the effect may be the same."

I was beginning to feel cold. I hadn't really thought about that, but it's true. And there's plenty of evidence that too many humans do feel that way. Vital statistics are pretty sparse these days, but it's quite clear that births are way down and disease deaths and emotional disturbances and suicides are all up. Cannibalism has started to crop up here and there; some clergymen vehemently denounce it, others find ways to make it sound positively noble as the ecologically best way to dispose of undiseased dead. But some people have a simply morbid fascination with it . . .

No wonder I'm not as cheerful as I used to be. No wonder I'm reluctant.

But how can I tell Pinocchio all that? He has enough problems of his own.

"Maybe," I said tightly (and I think this is as low as I ever got), "after what humans have done to you, we deserve to die too."

"And what good would that do?" he asked gently, undulating over to rub his side very slowly against mine. "It's too late for us. But suppose you let yourselves die out too. Suppose you've done this much and then not even you carry on. Then everything is lost, instead of just almost everything. All the destruction—for nothing. Do you want that? I don't."

I reached out to rub his forehead. It was impossible to stay even mildly annoyed with somebody who could hold that attitude in his situation. "I don't either," I told him. "Especially if you feel that way. But for myself . . . my heart's still not in it."

"Then we should all talk about it," he said suddenly, and he was darting away, his dorsal fin brushing my hand aside as it passed. Before I could try to guess what he was talking about, he pressed a big red button at one end of the pool with his beak. Then he swam back to me and kept making nervous little motions.

"What was all that about?" I asked.

"You'll see."

Moments later, the door swung open and Mason Orlik appeared at the side of the pool, having obviously hurried. "What's up?" he asked anxiously.

So Pinocchio had called him. "Can you arrange a long-distance conference call with my translator hooked into it?"

Mason looked as surprised and puzzled as I felt. "I suppose so. It'll take a little while to set up, but I don't see any reason why it can't be done."

"Good," said Pinocchio. "Sandy

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A Calendar of Upcoming Events

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6-9 September
CompCon 77 (I.E.E.E. Computer Society) at Washington, D.C. Info: Meetings Inquiries, I.E.E.E., 345 East 47th Street, New York NY 10017.

19-21 September
Meeting on Cybernetics and Society at Mayflower Hotel, Washington, D.C. Info: Meetings Inquiries, I.E.E.E., 345 East 47th Street, New York NY 10017.

26-28 September
EASCON 77 (Electronics and Aerospace Systems Conference) at Arlington, VA. Theme: The Future is Now. Info: Eascon 77, 19 Firstfield Road, Gaithersburg MD 20760.

30 September-2 October
PgHLANGE IX (Pittsburgh area SF conference) at Sheraton Motor Inn North, Pittsburgh, PA. Registration $5 in advance, $7 at the door. Info: Barbara Geraud, 1202 Benedum-Trees Building, Pittsburgh PA 15222.

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30 September-2 October
STARCON 77 (SF and fantasy and films) at San Diego, CA. Registration $12 until 31 August (mail registration cutoff date), $16 at the door. Info: Starcon San Diego, c/o Mrs. E. Boyer, 4474 Winona #5, San Diego CA 92115.

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30 August-4 September 1978
IGUANACON (36th WORLD SCIENCE FICTION CONVENTION) at Hyatt Regency, Phoenix, AZ. *The meeting of the SF world. Talks, panels, films, masquerade, art show.* Here will be presented the Hugo awards and the John W. Campbell Award for Best New Writer. Registration $15 until 31 December 1977, $20 until 31 July 1978, $25 thereafter and at the door. Guest of Honor—Harlan Ellison; Fan Guest of Honor—Bill Bowers; Toastmaster—F.M. Busby. Info: Iguanacon, P.O. Box 1072, Phoenix AZ 85001.

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and I would like to talk to her mate."

It's crazy, I thought over and over as I waited. I had no idea, either that the possibility existed or that Pinocchio would take so active a role in trying to change my mind. I can't say I'm enthusiastic about the idea, but I didn't try to stop him. I'm not sure why. Maybe I want to cooperate with anything he suggests because I'm still clinging to a desperate hope that somehow I can get him to change his mind. I don't want them to be the last. Or maybe I feel guilty because I haven't called Jonel yet and I'm using Pinocchio's crazy idea as an excuse to make me do it.

Or maybe part of me is secretly hoping that he'll succeed.

Mason says we'll do it this evening. I'd rather just go ahead, but he says he has to rearrange some of the electronics to get the picture-phone circuits and the pool mikes and translator working together.

Waiting, as usual, isn't much fun. I keep thinking too much. I think about what Pinocchio said about human problems being small compared to dolphins'. It's embarrassingly true, of course. For that matter, Jonel and I are more fortunate than many humans. We still have an entertainment console that works (though we don't often find it very entertaining); more importantly, we have some of our personal things like pictures and books and my oboe and guitar. Our recycling plant is in a central location in the building so it doesn't clutter up half our apartment. We still have Ozymandias the Mutt, though he's beginning to get old. We even get to see a few other people in the flesh once in a while.

But very seldom. It's too much trouble, and too many of the people we'd like to see died in the acceleration buildup (and had their homes cannibalized for material to fit those of the survivors). The food is monotonous and meagerly rationed, and the air is always stuffy and stale. So is the routine. I'm an outdoors person, and the outdoors isn't there anymore.

I like to think I'm an adaptable person, too, but it's taking a while. It's just *so* different from everything my life was full of.

I'll come around. But . . . today?

Beldan has been pretty quiet through all this. He likes Pinocchio and enjoys talking to him—usually. But when we get to talking about what's happened to the dolphins and what can—or can't—be done about it, he's so completely at a loss that he doesn't say anything.

But he plays his pipe a lot.

19/5, 3

I'm still a little dazed, but I must try to reconstruct what happened last night and today and get it on paper while I'm still close to it.

Mason had it arranged within an hour after dinner. He took us into Pinocchio's room and explained the setup, then left. Beldan stayed. I didn't feel quite right about having him there for this, but I couldn't bring

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myself to ask him to leave.

And I'm glad I didn't.

I dialed the phone—located on the small cart of extra equipment Mason had wheeled in and hooked to some cables brought through the wall next to the screen—and sat down on the edge of the pool to wait. I heard the irritating buzz of our phone ringing at the spaceport, and then Jonel's voice. "Hello?"

I was very glad to hear him. "Hello—" I said. But I was drowned out by Pinocchio. The screen showed him saying, "Hello, Jonel. I've enjoyed talking to Sandy so much I wanted to meet you too—"

"What?" said Jonel, obviously puzzled.

"Turn your picture on, Jonel," I said. "It's Sandy."

"Sandy!" he exclaimed. "I've been wishing . . . OK. It's on." We still didn't see him, unfortunately; Mason hadn't hooked up a picture receiver. "Now, what was that? Is your voice changing?"

I laughed. "No, that was Pinocchio. Pinocchio, say it again. He couldn't see the translation."

Pinocchio said it again. I watched the screen; a direct electronic pickup sent Jonel the signal without the need for a camera to block my view. "Did you get it that time?"

"Yes. I'm glad to get the chance to talk to you, Pinocchio. I didn't expect—"

"Don't let him fool you," I warned. "He has ulterior motives."

"Ulterior motives?"

"Yes. He wants to play marriage counselor."

"What?"

"He thinks you and I should start a family, and he's taken it upon himself to try to sell us the idea."

"Sounds fair enough," said Jonel. "That's about what you went to do to him, isn't it?"

"Yes—," I began, reflecting that Jonel knew very little of the details.

"—but I'm afraid," Pinocchio interrupted, "she's failed." I broke off and listened intently, watching the screen, seized by a sinking intuition that this time it was final and I really had failed.

"I've thought about it all day," Pinocchio said, "and while what Sandy suggests is tempting, in a way, it would not be wise—for us. We are different enough—humans and dolphins—that I don't know whether I can make her understand why it would not be wise. But I know it wouldn't—and Topsy and Turvy know it wouldn't—and we are so certain that we've decided not to think about it or talk about it any more. There's no point in tormenting ourselves."

"Topsy and Turvy are two females who came with Pinocchio," I explained to Jonel. It seemed to me that Pinocchio looked surprisingly calm, and the little that appeared in the third column of the screen bore that out.

"Yes," said Pinocchio. "Sandy tells me we should keep going because there'll be a better future. This is

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probably true; for your sake, I hope so. As I understand humans, the belief can sustain you through a lot. Futures mean much to you, and you can adapt to confinement and discomfort. We can't—or at least we can't without pain that seems too great to inflict on children. We're too used to open space; play is too big a part of our lives. We can't give it up for several generations."

A trace of amusement appeared in the third column. "I suppose," Pinocchio mused, "it must seem to humans that we're frivolous, that we have too much playfulness in us. It looks like they're right—under the present highly unusual circumstances. But it seems to us that humans often have too little. We hope you make it through this—if you do, we'll be satisfied that it wasn't a total loss—but in doing so, be careful not to lose what you have of that.

"It's going to take special people to be sure that doesn't happen. Sandy is a special person, Jonel—and I can tell you must be too. If all this is going to make any sense at all—"

And suddenly everything stopped except his clicks and whistles. In one tiny fraction of a second, the translator screen went dark, the hums of the machinery in the walls cut off, the lights vanished and we were plunged into utter darkness.

And my insides twisted themselves into a knot.

The umbilical cords—

I'm sure I didn't scream, or anything like that; I'm not a hysterical person. I do remember croaking, "Jonel!" and choking it off as I realized he couldn't hear me any more. Whatever Pinocchio was saying faded abruptly. For a time that felt terribly long, though it was probably only seconds, the silence became almost as complete and oppressive as the darkness. Almost, but not quite—there was still the soft *lap-lap-lap* of the water, and the muted thunder of the blood pounding in my ears. But otherwise there was nothing. The hum of the machinery was hardly noticed when it was on, but its sudden absence was overpowering.

Soon new sounds started up in the blackness. Pinocchio swam around, making creaking door noises, stirring the water up. Beldan's pipe began to weave something simultaneously plaintive, frenzied, and (to my ears) eerie. Pinocchio came to rest against my leg and for a second or so was silent. And then he began the distress calls, those shrill, haunting whistle-pairs I'd previously heard only on the briefing tapes and in troubled dreams.

But now they were real.

A shivery feeling chased itself up and down my spine. Simultaneously, I reached carefully to touch Pinocchio, and started trying to collect my thoughts.

What happened?

Power failure; that much was clear. Completely unexpected—as they always are. Whether it was confined to this room, or the building, or covered

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a much larger area I had no way to know. But it was complete, at least here. It had knocked out too many things to be a malfunction in only one of the operating systems.

It got them all.

I wasn't ready to think about what that could mean. It wasn't necessary yet; with luck, it never would be. But already it was nibbling at the back of my mind.

I realized I didn't really know what all had happened even in this room. I knew all three of us were alive—my ears told me that—and since I wasn't hurt, I suspected the others weren't either. "Beldan," I asked softly, "are you all right?" My voice sounded hollow, with most of the background noise gone. And it seemed terribly wrong not to hear dolphin sounds from the underwater speakers after I spoke.

Beldan's piping stopped. "I'm all right," he said. I wished futilely that I could ask Pinocchio. "Do you know what happened, Sandy?"

"Not exactly. We've lost our power; that's all I can tell."

"What can we do?"

My answer was as hollow as my voice. "Wait."

"That's all? We can't call for help, or go out in the hall and see what's happening there?"

"We don't dare, yet. Mason or somebody might know what's happening and be able to help. But the electrical communications are dead, and the room's practically soundproof. And they may have lost pressure out there. If that's happened, we wouldn't want to open the door until somebody comes to cycle us through the emergency lock. So we sit and wait. They'll get it fixed, or get somebody down here, before too long." *I hope,* I added to myself, biting my lower lip. I thought a moment and added, "I can try pounding on the door."

I climbed out of the pool, groped my way to the wall and along it to the door, hit it with my fists and yelled a couple of times before I remembered that it *was* an emergency lock and I was wasting my time. Nobody'd hear that either, and I should have known it. *Slow down,* I warned myself. *Take it easy. Panic's not your style. Just wait.*

I felt my way back to the edge of the pool and sat down, trying hard to take my own advice. It wasn't too bad for the first hour or so. Pinocchio kept up his distress calls, over and over, with unchanging urgency, for most of that time. I kept wishing I could tell him what I'd told Beldan, tell him that he might as well be quiet until the trouble was fixed or help came. The endless whistles could easily get on anybody's nerves—especially in the dark with Beldan piping too. But finally Pinocchio did quit, of his own accord.

Then I worried about whether something new was wrong with him.

And all the while I kept thinking of what must be running through Jonel's mind, wishing I could tell him I was all right.

And hoping he was. After all, I

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didn't really know the extent of this thing . . .

I lost track of time. I have no idea how long that "first hour or so" really was; I do know subjective time sense can be wildly distorted by stress or sleeplessness or any number of other things. Even allowing for that, I eventually felt quite sure that the time we'd been trapped there in the dark was measured in hours rather than fractions.

And that made it harder to keep the other thoughts down—though I did manage to resist talking about them for quite a while.

What's keeping them? I thought. *Have they forgotten we're here? Surely somebody should have come by now, if only to reassure us and take us somewhere else.*

Unless something's happened to them . . .

I didn't want to think about that. But I did, more and more often.

And I thought of people I'd known whose umbilical cords had failed. Some got them fixed in time to regale their friends with tales of the experience.

Others . . .

Well, they did provide much-needed subjects for small talk.

Beldan and I talked occasionally, but not often or long. I think we started when one or the other of us felt an especially acute need for comfort, and stopped when we realized that neither of us felt up to talking very long. Sometimes he piped; once he asked me to sing, and when I did Pinocchio rubbed against my feet and made noises of his own.

Discomforts accumulated and grew more insistent. First there was just the darkness and the silence and the fear and uncertainty. Later, in addition, I found the air feeling stiflingly damp and stuffy; it stank, and seemed to be getting colder. Sometimes I would start shivering, and it seemed to me that my pulse was too fast and I was having trouble breathing. I tried to estimate how soon we would be in any danger from carbon dioxide narcosis, with the recycling plant not working, but I couldn't. I was too tired. I couldn't remember clearly, and I couldn't do calculations in my head.

And I was hungry, and thirsty and . . .

"Beldan," I said, and I was appalled at the weakness of my voice, "do you remember the fresh water tap on the wall near you?"

He had to stop piping to answer. "Yes."

"Does it work?"

"I'll see." I heard him moving cautiously, heard him find the faucet and try to turn it on. "Nothing comes out."

Not surprising, I thought. *Pump's out, and who knows how much else.*

I drew my feet out of the water and sat huddled up, hugging my knees against me for warmth. "Beldan," I asked slowly, hating even to mention it, "what would happen to everything . . . out there . . . if anything should happen to you?"

He didn't answer right away. "It

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will carry on. It will complicate matters, of course. But the Coordinator will prepare a replacement for me." He hesitated, then added almost inaudibly, "If there's enough left of the Coordinator."

Then he went back to his piping.

Not long after that, I stretched out on my back and tried to sleep. I must have dozed now and then, but it was always shallow and full of dreams I could easily have done without. Sometime during one of the half-awake, half-asleep episodes, I remember thinking, *If I ever get out of here, I'll . . .*

And the thought stopped, idling against an immovable obstacle. What could I do?

A long time later I thought of an answer. A bitter, hard-to-swallow answer. *If I ever get out of here,* I thought, *I'll go back to doing the same old things, with just as little control over them. And I'll pass every day in fear of this happening again.*

For as long as I live.

That made me angry. I was too groggy to try to do anything about it, but I lay there letting it simmer in a dreamy stew.

And suddenly I saw, with such simple clarity that I marveled at how it had eluded me for so long, what was wrong with everything.

And for the first time, I actually saw something I *would* do.

If I ever got out.

I was sleeping a little more soundly when they finally came. Gradually, dimly, I became aware that the noises of someone trying to get in existed outside me and not just in my dreams. I turned my head slightly toward where I thought the door was, but otherwise I didn't move. *It's over!* I thought, and in the same breath warned myself against premature poultry-counting.

The door swung open and the glaring tips of two flashlights appeared, enough of their light bouncing back from the walls to show Mason Orlik and Bill Maracek, looking a bit sinister in the darkness. "Everybody all right in here?" Mason asked softly.

"Yes," Beldan said dully.

"Still living," I said, managing a weak smile. "What took you so long?"

"Sorry," said Mason. "We didn't know where the trouble was—in the building or out. Had to check everything we could right away in case it was here. This room's pretty far down the line."

"And you found . . . ?"

"Nothing. Trouble's outside somewhere. We kept checking with a radiophone on emergency batteries, but for a long time it had nothing. I think some idiot thought he'd reduce panic by not admitting the trouble was widespread. But they finally announced that it covers at least the whole Cape."

I shut my eyes. So it wasn't over yet. The danger was still real, and still unresolved. "So what now?"

"We wait some more. But at least we can wait together, and a little more

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comfortably. I'd suggest that all of us land-dwellers go up to my apartment. Meanwhile . . . I brought you some things." He knelt beside me and I laboriously sat up. Bill went over to Beldan. Mason wrapped a blanket around my shoulders. "Thought you might be a little chilly," he said. "And thirsty . . ." He handed me a quart bottle of water, and I downed half of it in one greedy guzzle. "And hungry." An algae patty. It had been a long time since I had any idea they could taste so good.

"Infinite thanks," I told him, feeling a shade better. "Have you been in *touch with Jonel since we were cut* off?"

He shook his head. "Afraid not. The phone doesn't have much range on E batteries. We tried, but no luck."

He must be worried sick, I thought. *Well . . . not quite. Not Jonel. But plenty concerned.* For a wistful moment, I envied him. I can stay fairly cool in a crisis, but he does it better than anybody I know. I guess an astronaut has to.

But we're all astronauts now . . .

Mason put a flashlight in my hand and helped me up. He and Bill and Beldan and I went out through the dark corridors and up the stairs to his apartment. I told Pinocchio we'd be back, though I knew he couldn't understand me.

We sat around by the light of a single flashlight pointed at the ceiling and waited some more. According to Mason's wind-up watch, it was almost three in the afternoon when we went up. Time passed a little more easily now, with human furniture to sit in and more of us to talk. But still it dragged, and though we said little about it, I'm sure we all thought more and more about the things that would happen if power wasn't restored soon.

It came back all at once, with no warning from the radio, a little after seven. One second we were sitting there in darkness and uncertainty; the next, the lights were on and cozy hums came softly from the walls and everything looked very ordinary. (Except that I was sitting there in a wet bikini with a layer of drying salt on my skin and a blanket wrapped around me.)

"Thanks," I murmured, too drained to do more, "to whomever it may concern . . ."

And then I jumped up with a startled cry of remembrance. "Pinocchio!" I ran out the door and down the hall, the others close behind me. We used the stairs again, afraid to trust the elevator until we were sure everything was really back to normal.

The lights were on and the walls humming in Pinocchio's room, but there was an unpleasant smell of air and water that had sat too long without recycling. Pinocchio lay motionless right where I had left him.

"Pinocchio," I asked anxiously as I threw the door open, "are you all right?"

He flipped his flukes and swam closer, but he looked tired. He made a

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complicated series of vaguely excited-sounding noises.

But the translator screen remained blank. And I realized belatedly that nothing had come from the underwater speakers when I called to him.

Mason swore. "Of all things to get knocked out and stay out! Well, I'll get somebody working on it right away. Meanwhile, I know what some of those noises mean. He's starved."

I smiled. "I can sympathize with that. So am I. But I've got a phone call to make before I do anything about it."

I called right away, from my room. There was a little trouble putting the call through, and I was momentarily afraid something was still wrong. But it was nothing serious, and within a couple of minutes I had Jonel's voice in my ear.

And it sounded *awfully* good.

" . . . power failure," I explained. "Still don't know the details, but it was all over this area. For a lot of hours there, Jonel, I really wondered whether I was ever going to get to talk to you again. And I didn't even get to say good-bye."

"I didn't know what to think," he said. "But it certainly is good to know you're all right." He chuckled. "Have you ever noticed, Sandy, that when you go off on excursions with Beldan you have a habit of getting into situations that scare me more than anything that's ever happened to me?"

"Yes," I laughed. "Sorry about that." I leaned eagerly closer to the phone. "But I learned something from this one, Jonel. Something important. I'm ready to start that family of ours now—"

"Great!"

"—on one condition."

His voice took on a slight tinge of caution. "Well?"

I was talking fast, excitedly. "In the middle of all this, I realized that our problems—my attitude—are a microcosm of what everybody's up against. And if we don't solve them, we're going to . . ." I trailed off. I was going to say, "go the way of the dolphins," but I still couldn't bring myself to admit out loud that Pinocchio was the end of their line. I didn't finish that sentence. "The basic problem," I went on, recomposing myself, "is that we're so completely, helplessly, pathetically dependent on this artificial environment we've thrown together. And that there's no end to it in our lifetime."

I paused, waiting to see if he would say anything. He didn't. I went on, "Do you remember, back at the end of the first month, when Henry and the Kyyra were conferring on how high an acceleration to use?"

"Yes."

"Henry rejected the high value Beldan wanted us to use because its side effects would be too drastic. And he rejected keeping the low one we'd already reached because it would take too long. Three thousand years, he told Beldan, is no different from forever, to a human. So we compromised. Well . . . three hundred years is no different from forever, either. And

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that's what's been bothering me, and a lot of other people who feel the same way."

"But what can we do about it?" He already knew what I was driving at; I knew that. But he had to hear me say it—to be sure.

"The high acceleration Beldan was pushing for," I said. "The half gee or so they claim they can do. Jonel . . . do you think they really can?"

"I think so," he said slowly. "I've talked to Zhalãũ some more, and I think they can use a pretty high acceleration and get a significant part of the planet and some of its inhabitants to their destination. *But* . . ." he paused for emphasis " . . . the acceleration effects *would* be much more drastic. Conditions would be a lot worse than they are now."

"I realize that. But they could have an end, within the lifetimes of people now living. That would make all the difference in the world to me—and I think to a lot of the other people, too. And we could take more time to get ready for it. I think it's worth it, Jonel. I didn't before, but I do now. Very strongly."

He was silent for a while; I wished I could see his face. Finally he said, "Do you realize how *much* worse it would be?"

"You showed me the calculations," I reminded him. "But I'd rather have a tooth pulled once than a permanent toothache for the rest of my life."

"Even without anesthesia?"

"Even without anesthesia." I tried to picture a dentist finding a way to get forceps into my mouth while I was biting a bullet . . .

Jonel was silent even longer that time. Then he said, "I'll talk to Henry. I love you, Sandy."

"I love you, too."

And now it's late and I'm exhausted and I'm going to my bed and collapse.

And hope.

20/5, 3

Morning: Jonel called me back—woke me up, but I didn't mind. Henry's rechecking the high-acceleration options, with the computer and Zhalãũ (the chief Kyyra engineer) and his own judgment. And this time he's paying special attention to my hunch about the psychological factors.

Some other news isn't good. They still don't have the dolphin translator fixed; it seems to be a worse problem than Mason thought at first. He's concentrating everybody he can on that right now, and he's working on it himself.

And Topsy, whose health has always been a concern, is definitely sick. Mason isn't sure what it is, but he thinks it's some sort of a virus. It must have already been there, but her resistance was lowered by a combination of factors like psychological strain (which was already pretty bad) and loss of proper environmental control during the blackout.

He's afraid Turvy's coming down with it too. He's given them both shots which he thinks should help.

Pinocchio shows no sign of it. But I

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certainly hope we can talk to him soon.

Jonel called again this evening. I'm delighted, and Beldan is as pleased as I've seen him in a long time. Henry's finished his reanalysis of the acceleration problem, and he's reached a decision, well before the end of the moratorium he'd set aside for it. He's convinced that the psychological problems of the way we're doing it now more than outweigh the physical dangers of the other way. He and Zhalãũ have worked out details, checked with Beldan, and Henry's decreeing a twenty-year plan to prepare Earth for high acceleration.

It'll be hard, all right, and the whole thing will still take over thirty years—maybe even forty, depending on how tricky things get toward the end. But it gives me a fighting chance to see the end. That's all I ask.

Like I told Jonel yesterday, it means all the difference in the world. I feel more like myself now than I have in months. I'm actually eager to start a family again.

I don't know why I didn't think of it sooner, but this may make a difference to Pinocchio, too. I have to talk to him as soon as possible, but the translator's still out.

21/5, 3

I'm numb. The translator still isn't fixed, and it doesn't look like it's going to be. They found the trouble this morning; Mason says a power surge when things came back on apparently blew a couple of special IC's that'll be well nigh impossible to replace these days. He doesn't understand why the usual surge protection failed, but that's no consolation; it did.

Worst of all, both Topsy and Turvy died during the night. Pinocchio still shows no signs of catching what killed them, and Mason doesn't think he will. But he's definitely the last now. Mason says he doesn't have to be; he's saved cells which he thinks the lab may be able to keep till the end of the trip and then use to grow new dolphins. But he doesn't understand. They weren't just an organism. They were a culture, a civilization.

And that will die with Pinocchio.

Tony's flying up this afternoon to take Beldan and me home. I can hardly wait to get back to Jonel. But before Tony comes, I've got to go down and tell Pinocchio good-bye. He won't understand my words, and I won't understand his—"words." But we can communicate, a little. I'll get in the water with him, and I think I can make him understand my sympathy (for what little that's worth) and at least a little of the more complicated things I feel for him.

And then I'll go home to Jonel and we'll start getting ready. Somehow, we're going to have children who can stay hopeful—and playful, Pinocchio—right through all this. We have to. I'm not in that kind of a mood now, but I'll get there as this passes. With the possibility of an end in sight, I think we can do it.

And after what we did to Pinocchio . . . We owe it to him. ■

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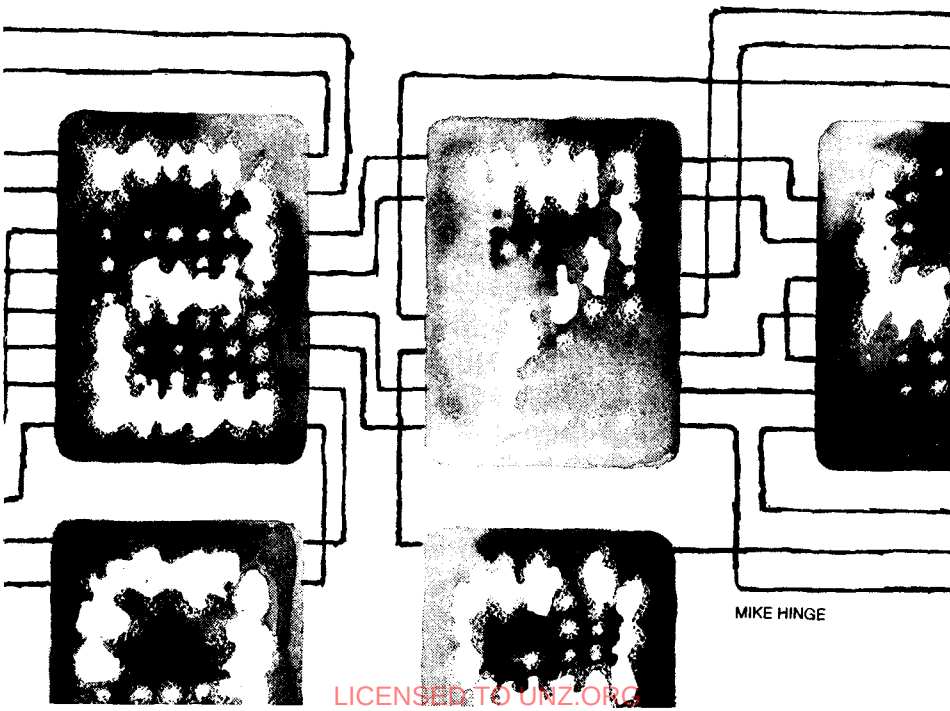
the astrological engine

Engineering is the art
of making the universe manageable.

Charles Ott



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I'm more of an engineer than a manager. For six years, I've been solving personnel problems in this shop by taking our prima donnas out to get them companionably drunk, which isn't something they tell you about in management seminars but seems to work pretty well. In fact, it's just a good thing they've never hired a teetotaling engineer in this section, because I wouldn't know how to handle him. But you can't play iron man forever—just at the moment, I was slopping around the office trying to get someone to take the hint and take *me* out to get drunk.

"Hey, Davis, how'za boy?" I asked cheerfully, standing in the doorway of poor Davis's little cubbyhole. "Work going all right? How's everything? Listen, do you want to take off a little early this afternoon, maybe we'll stop off someplace? Go ahead, be my guest." Davis was about the best engineer I had, although he had sort of a funny attitude about the work. Somebody must have gotten to him not too long ago and made him feel guilty about being an engineer, because he'd picked up the attitude that the only important thing in the world was solving people problems. Davis really loved his job, but just hint that something was bothering you and he'd bounce up out of his chair like a jack-in-the-box, bobbing around trying to help. He wasn't any good at it, but it made him a good guy to drink with just the same.

"Why sure, Gordo," he said immediately. Everybody in the shop calls me Gordo, even though I'm the boss. I make a point of it.

Even with all the other little electronics companies moving into our corner of Santa Clara county, things are still pretty spread out, not surprising considering that the whole area was fruit orchards not seven years ago. The bars are few and far between, and the ones I'd consider drinking in are even scarcer. Eventually, though, we found a good place filled with people from one of the larger memory-chip outfits down the road, so we fit right in.

I ordered Scotch for myself and a Manhattan for Davis: I know what everybody in my section drinks. "You know, Gordo," Davis said by way of opening the conversation, "I was up at a seminar at the Taproot Foundation retreat house this last weekend, and they were talking a lot about how we all tend to surround our emotions with rituals, so that we can bring them out. The first guy I thought of was you—like how you always want to have a drink in your hand before you talk to people, even though you don't drink very much, because I guess you can't really express your real inner feelings without . . ."

"This last weekend? I thought you were out learning to meditate or something, weren't you?"

"No, that was the week before. See, meditation is something you only have to learn to do once, and then you can go on to other things. The Taproot Foundation is something my wife turned me on to, and believe me

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Gordo, if you went down there it would make a great change in you. What you want to do is, is to learn to bring out your deepest feelings and lay them out on the surface so you can deal with them. Just to show you, I used to have this problem with sexual inadequacy with my wife, and they showed me . . ."

I tuned him out for a while, since Davis can run on like this for a considerable period. He was sure right about one thing: Davis didn't need to drink to be able to talk like that. When I first met him, he was one of my students at Caltech, one of those grim grad students they turn out who spends all his time in the lab. Davis has always had a problem with acne, and in fact his face is still pretty rough even though he's pushing thirty, and I guess it made him shy. At any rate, he was a brilliant engineering student and when I came to Technovation to work, I brought him along. Starting then, or perhaps starting with his marriage a little later, Davis started to bloom. Now he wears these snazzy Pierre Cardin suits and drinks wine at home, and his wife hauls him around to these group-grope therapy rackets every week. He's in the process of discovering his emotions the way some people go bowling on Friday nights.

" . . . And so I found, after I'd wrestled with it for a while," he was saying, "that the real blockage in my self-actualization was not that I resented my lack of sexual experience, but rather that I was stuck in a self-destructive pattern of only expressing my resentment in one situation, in bed. So once I had that clarified, as we say, for me, I was immediately able to improve my performance."

You have to learn to understand Davis. Basically, he was a good guy. It was just that he truly believed he had an obligation to blow his soul to his friends this way. "Davis," I said, "You're trying to tell me I should talk more about my problems, right? I've got news for you. This one is going to be a problem for you and me both." I got up and fetched another round of drinks back to our booth. "Marketing sent some people around to see me the other day, about a calculator they want us to develop. It's a hell of an idea. It's going to make us rich."

Davis nodded sagely. "You know, I can sure see where that would be a problem for people who have trouble internalizing an external change in the frameworks of value systems."

"Knock it off. That's not the problem. The problem is that the guys in the shop are going to put out a contract on me when they hear about it. Hey, damn if I don't need another drink." Eventually I told Davis all about it, and for once he was speechless. Really, it was gratifying to see his jaw just drop lower and lower.

Marketing sent some people in early the next morning to leave little cheerful notices on everybody's desk, telling them to be at a staff meeting at ten o'clock. I went right to my office and hid there against the chance of someone asking me a question, but I

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noticed through my door when a gang came in around nine-thirty to set up an easel and lots of colored-tape-and-cardboard charts. Apparently the head office knew perfectly well that they'd have to sell this one to the employees as well as to the public.

I was introduced to the Project Coordinator for the operation, a short black woman named Sally McFee. Most of our people were a little annoyed at being called away from their desks anyway, and when Sally stood up before that crowd of tall gangling circuit designers she looked like a rabbit facing a wolf convention. Then she gave them all her toothiest grin, and more than half of that was snarl.

"Good morning!" she said in a cheerful no-nonsense way. "I thought I'd start out today by bringing you some news about some of our recent projects. You'll be glad to hear that the artillery calculator—,"she held up a calculator in a heavy olive-drab case, "—has finished its initial production run and the Army loves it. In fact, we've been able to sell the same line to the Navy and even charged them ten percent extra to change the case color to gray. Our Sportamath line is ready for national distribution just as soon as we can write an instruction booklet that will be intelligible to our prospective customers, and we hope to have it out by baseball season. The KiddieKalc line you designed last year has just gone into test marketing in Atlanta, and it looks great."

By this time, of course, everybody knew they were being set up for something. They weren't wrong. "As you know," Sally went on, "Technovation has always been the market leader in new applications of calculator technology. We've thrived because we had the courage to see and develop new specialty markets *first*. And now, we intend to develop a new product, a whole new leap in microprocessor application, that will drive Technovation right up into the majors!"

At this point, I suppose Sally intended to stop for a silent dramatic pause. However, the junior draftsman we'd sent downstairs for coffee arrived at that moment and the theater of her pause was lost in the hubbub. By the time everybody had settled down again, Sally was a little disconcerted.

"You'll understand," she went on gamely, "that we haven't dared to do any pretesting on this because it's *got* to be kept secret. What we want is—the world's first astrological pocket calculator."

Hoskins dropped his coffee. Slovak blew some of his through his nose, putting him out of the picture temporarily.

"You're putting me on," somebody finally said, in a dismal defeated voice.

"Not at all! The marketing potential is enormous, just staggering. We estimate sales in the millions for this item. What we want, what *management* wants, is a calculator that will accept as input a location in latitude

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and longitude and a time, and will present as output an astrological horoscope chart. The customer can use the calculator to find his own birth chart, or the charts of his friends, or charts of the current moment, or charts for the future. Believe me, gentlemen, it's a natural."

Davis, I saw, had prudently slipped into the background. A good thing, too, because in front the gang was beginning to lean forward in a belligerent way. "This is ridiculous!" one guy said. "We'll make a laughingstock out of the company. Whose idea was it to get mixed up in this witch-doctor stuff anyway? Yours?"

"Uh-huh," Sally said equably.

"I don't believe you're serious! Next thing you'll want a pornographic calculator or something."

One of the peculiar things about working for a small electronics outfit like this one is that we get a lot of college whiz kids who are a little too whacked out for the bigger companies. I spotted a kid in the back, name of Doheny, a skinny adolescent who was supposed to have been a boy wonder at MIT. He got that abstracted look in his eyes. "Jeez, a porno calculator?" he mumbled. "I don't know if there'd be much potential. I mean, there's only about seven basic positions, right? So even if you get more than two people into the act, that's still only . . ."

"Wait a minute," the kid next to him said. "What about the minor variations? Now, the way I see it . . ." and they wandered off into the corner, talking a mile a minute. I let them go.

"I know you can do it," Sally was saying. "Look at the charts here and you'll see that there's a real desire in this country for such a product, if our assumptions work out. You'll be performing a public service by giving the public what it wants. We'll get you all the technical help you need on this design, but speed is essential. We really want to get moving on this."

"Count me out," a voice said in the back. "I'm a practicing Catholic."

I couldn't let that pass. "Braverman," I said to him, "you worked on the Army job."

"That's different."

And another guy: "But what am I going to tell my *wife?* For that matter, what am I going to tell my friends when they hear what I've been working on?"

It was beginning to look like I'd have to get between Sally and my people after all: Sally was slapping her wooden pointer into her palm as though she meant to start swinging it. "With the money we can make from this," I said, "you can afford a new and better class of friends anyway. Now look, you're all employees here and management's word *goes* and that's that. Now, are there any substantial questions?"

"Yeah. Do I have to sign my name to the drawings for this?"

"Yes. All right, if there aren't any real objections, here's the plan. Management wants this job finished on top priority, so we're going to be putting

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everything else aside. First, we'll need to work out the input and output specs, and then we get busy drawing the mask designs pronto. OK?"

"But Gordo," one of the older guys said, "who the hell knows anything about astrology here? Or maybe I should put it this way—who knows anything about astrology and is willing to admit it?"

"We've already thought of that," Sally said. "I'd like you to meet the resource person on this project. This is Bernard Medenbrook, AFA."

"AFA?"

"American Federation of Astrologers." Medenbrook was a shy young man dressed like an undertaker: I hadn't even noticed him standing next to Sally. He wore a plain white shirt with his dark gray suit and black oxfords, and his black hair was cut in what must be California's last surviving crew cut. He grinned uncertainly and flashed his glasses at us.

"Hi," he said, and lapsed into silence. Sally picked up the slack.

"What we decided is that Bernard will teach you the fundamentals of astrology over the next few days, enough to let you design the calculator. After that, Bernard will be around for consultations until we finish the whole manufacturing process, and he'll also be writing the instruction book."

"He can't stay here," Hoskins said immediately. "We only have just enough desks for ourselves. He'll have to go to another office or something."

"We'll bring in another desk," I said sternly. "Let's knock off until after lunch, and we'll start again at one o'clock in the seminar room." Sally collected her charts and took her leave. When I looked around, the place was deserted: my whole crew had cleared out like a flash. Medenbrook was standing around with his hands in his pockets, not looking at me.

"Come on, Bernie," I said. "I know a good place to eat, where we can get a drink."

The first person I saw after lunch was Doheny, sitting in my office sketching quickly on a scratch pad. "Hi, Gordo. Listen, we've really got something here with the porno thing. See, we decided we can break the human body down into twenty-two pictorial components, which we can display on a liquid-crystal matrix. So with that, we can present two human bodies on a three-by-three square in any position. So then we key the limbs to a random number generator, with constraints to the possible sexual positions, see, so that when you push the button . . ."

"Doheny, get out of here."

If the gang had been a little stunned and uncertain during the morning meeting, by the time we began in the afternoon they'd been able to work themselves up into a fine froth. You could tell they were all hopped up on adrenaline and meanness: the place smelled like a locker room. When Bernie came in, carrying his own

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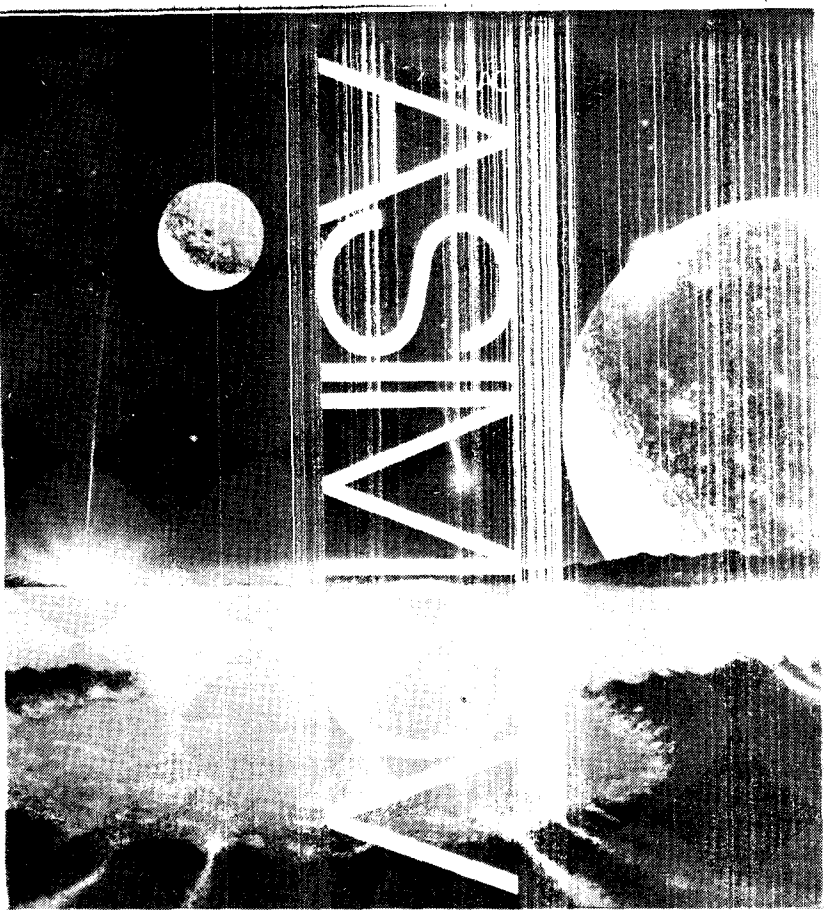

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collection of cardboard charts, he turned pale just looking around.

"OK," he said, and stopped to swallow. "Um, OK. If I could just begin . . ." He stood wretchedly for a few minutes while everybody took chairs, banging them unnecessarily and making lots of comments. "I thought today maybe we could . . ."

"*Did* you think?"

"Knock it off, Jaspers!" I yelled. "This is business. Now let's settle down. Anybody else who interrupts gets thrown out."

"Doesn't he have to swear us to secrecy first, so we won't tell these occult secrets to the crass masses?"

"Wait a minute, I'll light some incense."

"Should we get a draftsman to draw a pentagram on the floor?"

"KNOCK IT OFF! If you think I'm kidding, try me. Bernie, go ahead." Bernie launched into Introductory Astrology 101, and presently the room subsided into a sort of uneasy truce. I was wandering around while he lectured (being the boss has advantages) and looking at the notes people were scribbling. Every note was a quibble to be tossed at Bernie during the question period.

I solved that by not letting them ask questions.

By the third day, we had enough information to get started. Bernie's dogged persistence had begun to win a little respect from the engineers, but they still insisted on a visit from one of the astronomy professors at a local school, to check up on the physical aspects. He was, if anything, even more indignant than our own people when he found out what we were up to, so we put him on the payroll as a consultant too.

The information that the calculator needed to display was an odd melange of medieval ideas and low-level astronomy. A horoscope is a composite of several circles: the inner circle represents the Earth (in a slenchwise sort of way: Bernie was vague about this) and the outer circle is a cross section of the Celestial Sphere. The planets are arranged on the Celestial Sphere, which I always thought of as being made of blue-tinted Plexiglas, in the positions they would be seen in from Earth. In addition to the eight planets I learned about in school, Bernie also insisted on including the Sun, the Moon, two things called the Dragon's Head and Dragon's Tail which have something to do with the Moon's orbit, and a totally abstract construction called the Part of Fortune. Bernie also said that charting the larger asteroids is all the rage in astrological circles now, but we decided to skip that.

The horoscope also includes the relative positions of two circular divisions of the Universe. The Zodiac, which turns out to be an abstraction not having much to do with the actual constellations, is the circle of the ecliptic cut twelve ways. The "houses" are a circle cut twelve ways also, in the plane of the Earth's equator.

In order to extract all the profound significance of this in psychological

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terms, the astrologer also needs to know the "aspects", which are certain angles between the planets, and between the planets and some of the dividing lines of the houses. After providing for an indicator of those, we also had to include an outer ring to display a second set of planets. The outer planets in the chart are either the current or future positions of the planets, which can be compared to the positions, or a sort of fortune-telling arrangement called "progressions". Progressions are calculated by an algorithm I can only describe as baroque.

It became obvious after a day or two that there was no way we could abstract this mare's nest of data into a stock, cheap LED display of numbers. For one thing, there's no way to make cheap LED figures for those weird planet and sign glyphs we needed. Our best idea was to simply present the horoscope pictorially by using the whole front of the calculator for a liquid-crystal display—in fact, I believe it was Doheny who suggested that. The matrix made Bernie happy, since his opinion was that astrological information was best given in astrological notation. Marketing went crazy for it, as well they might. Flashy stuff like that was their whole business.

We farmed out the display to a company named SoliData in the valley, rather than try to build it ourselves. Our next step, after finding equations to describe planetary motions from the proper point of view, was to begin designing the circuitry. The draftsmen were set to working steadily: although we wouldn't be drawing the actual LSI chip masks (we farmed that out too) we did need accurate drawings and bread-board diagrams. The daily bull-session on design was becoming a marathon idea-binge.

Bernie and Davis, after the initial chill had thawed out, turned out to take to each other like long-lost brothers. The longer I listened to Bernie, the more he sounded like Davis. He had the same earnest way of intense explanation, like an insurance salesman turned preacher. I would see him and Davis sitting around after hours, holed up in Davis's office. Davis would be hunched over in his chair, spreading his palms before him as he discussed his emotional hang-ups. Bernie would be pointing his finger all around his birth and progressed horoscopes, insisting they showed the same thing.

"His ideas are crazy, of course," Davis told me one day, "but I have to admit they're attractive for a guy like me who went to engineering school. All those numbers and everything, you know."

"Hey, don't lose your objectivity," I said. "Remember, the idea here is to make a product to sell to the great unwashed, not to get snared in it yourself. Besides, I thought you were the guy who wanted to look inward to yourself, not outward to the stars."

"Well, if you believe Bernie, it's the same thing. His whole shtick is that

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you can understand yourself by studying the planets and astrological abstractions, because one is the reflection of the other."

"The whole idea grates on me, I'm afraid. Do you really want to believe that everything you are has been laid down in advance?" I asked, and I wasn't being rhetorical. For all I knew, maybe he did.

"Not really—but it'd sure be nice to *know,* wouldn't it?"

To tell the truth, I wasn't much worried about Davis falling into astrology. It was more likely to work the other way: I think Davis had about convinced Bernie to try meditation.

I got a rude shock a few days later, when Bernie came around to see me. He was carrying a copy of Sally's horoscope, and it was printed on ordinary green-striped computer paper. It seems there have been computer horoscopes for years, and Bernie had assumed we knew about such things. I hadn't, of course, but in a few days I had tracked down a copy of the software and it was a great help in designing the chip. As it happened, I saw that same printout a second time, when Sally herself brought it around.

"See what Bernie brought me?" she said. "Isn't this ridiculous? You know, I don't doubt for a minute that we'll sell carloads of these calculators, but I sure have to wonder what kind of people are going to buy them."

"Don't you know?" I asked.

"Well, I know things like the probable demographics and income ranges and socioeconomic mix of our buying public, if that's what you mean. No, I'm just wondering in a personal way what those people get out of astrology. After we go into test marketing I'm going to do some interviews, I think."

"That's odd," I said. "I always thought you were really into this stuff."

"Me? Not a chance. I used to know something about astrology back in college, because it made a good joke at parties. But then I found out some of my outwardly-normal friends really believed in this crap. That scared me—I never went back to it." Sally graduated from CCNY and she'd always struck me as pretty tough: if she said she was shaken, it must have really gotten to her.

"My thought is that it probably isn't any worse than organic food or yoga or any of those other fads," I said. "They'll buy the calculator and fool around with it for a few weeks, and then they'll see how foolish it is. The price we charge will be worth the lesson, I'm sure."

"Oh, I'm not much worried about what the calculator will do to people. I figure there's always about the same number of damnfools around and they'll always find some way to express themselves. I might feel bad if the calculator sucked anybody into astrology who wasn't crazy already, but I don't expect that."

"Do you know Davis Cooper?" I asked. "Wears the fancy suits and has acne? He's the one coordinating the

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output to the display matrix. Anyway, I suspect he might be leaning in that direction."

Sally grinned immediately and then seemed to feel a little guilty about it. "Yeah, I've met Davis. We spent about two minutes talking about the weather, and then he began telling me about how he's learning to deal with latent *machismo* tendencies in defining his role with his wife. Doesn't that boy have any notions of privacy?"

"Not much. He's trying to learn to be an extrovert, I think, but he hasn't really got the swing of it yet. What I was going to say is that he's been hanging around with Bernie."

"I'm glad somebody is. That poor man." Sally did have a maternal streak in her, but I never learned to predict what would bring it out. "You really think Davis is drifting into that stuff?" she went on. "I'll have to have a talk with him, or it'll be on my conscience. OK, I'll check back with you tomorrow to see if anything's come up."

I waved her good-bye. I'd been hoping she'd talk to Davis. I think he still considered me as somewhat of his "old prof", which is to say that he discounted everything I said. Sally's hardheaded practicality would turn him around.

Compared to any other kind of engineering, calculators always seem a bit slapdash: as usual, we were revising the drawings every week to take advantage of new technology coming on-stream. The memory we settled on was a fancy new magnetic-bubble job, which not only had a 6K bit capacity but was permanent too, which let us load a lot of stuff into it that otherwise would have had to be hardwired. After the chip and the memory had been wired into frames and covered with insulation, they would look like nothing so much as a half-stick of Wrigley's. However, I guess some copywriter at the ad agency found out that the memory was made of a sheet of garnet and the chip was built on a sapphire substrate: when they sent roughs of the advertising around to me for comment there was a big sunburst with the words "Gemstone Circuitry!" I had to send them a sharp letter.

The ad agency also decided, with marketing, to name the caluclator the "Astrological Engine", which had a properly archaic sound.

The final design of the calculator was flat and light. It was a white plastic square three and a half inches on a side, with the back given over to double- and triple-loaded buttons and the whole front for the display. Bernie was very pleased with the range of functions we'd been able to put in: the calculator would produce natal (that is, birth) charts, progressed charts, simplified charts with only as many features as the user liked, charts with and without aspects and lots of other allegedly useful stuff. We even added a display of numbers at the bottom so the user could read out planetary positions to as many decimals as he wished. Bernie assured us this had

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almost no astrological use, but it looked good.

Surprises turned up nearly every day. I discovered that Sally had been doing some personal research, attending meetings of an astrology group in Santa Barbara. "Gordo,"[2] she said, looking harassed, "has Bernie ever *hinted* to you in any way that the way he does horoscopes might not be the only method?"

"Different churches?"

"Something like that, from what I gather. The system we've been using is apparently 'that old-time religion' that was good enough for granddad—something called Placidean system. The style they use in the Santa Barbara group is called 'equal-house', and I have no idea which one is more popular. If we guess wrong, we're sitting ducks in the marketplace."

"Well, it may not be that bad," I said. "We might be able to put in a conversion program on the chip. Ask Bernie to drop by and give me some background, will you?"

"I think I'll beat it out of him with a T square." She began to look a bit whimsical. "Do you know who I met at that Santa Barbara meeting? Davis's wife. She invited me back to dinner."

"I've met her. Very pretty gal."

"Um-hmm. She took me downstairs to show off her new freezer. Gordo, that freezer of hers would supply a regiment for a long winter's campaign. I've never seen anybody with that much food around the house."

"I suppose she's as compulsive as Davis—both of them are pretty insecure. I wouldn't be surprised if she was reinforcing him in this astrology thing," I said, and at that moment Davis himself came up and rapped on the door of my office. He let himself in, not noticing my red face.

"Hi, Sally. Gordo, can you spare a moment? I was just talking to the liaison man from SoliData about the display, and they've come up with something we can really use." He took a seat, sitting on the edge. "What it is, I've been worrying about the power that the display is going to have to draw. Of course, the liquid crystal isn't as bad as LED's, but since we have to keep a continuous trickle of power going to every junction in use, it adds up. Anyway, the SoliData guy says they can build the same kind of a matrix with something they call 'electrochromics'. Here's the technical data, but the upshot is that once you put through an impulse and change the color of a bit, it stays changed until you put through a second impulse to change it back. It's a terrific savings in power, and we can arrange it so the user can set up the display once and it'll remain even after the calculator is shut off."

"Hey, that's great," I said sincerely.

"It's beautiful," Davis agreed. "With this, the user can study his chart with all the leisure he requires, so as to understand the planetary influences with more wisdom."

"Davis . . . Davis . . ." I stuttered

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helplessly, and looked to Sally for support. But Sally just turned her head and looked down.

"What, Gordo?"

"Oh, hell. Davis, at least try and be a *little* cool about this, will you? I mean, you're my friend, and . . ."

He broke into a big puppyish grin. "It's great to hear you say things like that out loud, Gordo. You're coming along."

"Damn it, we're not talking about me."

"Sure. Well, I've got to get back to work." When Davis had left, Sally came over and put her arm around my shoulder.

We had a working model of the Engine sooner than I had expected, at least for the important circuitry. Davis built it himself, mostly on his own time. He had wired together a few old logic chips from our shelves, together with some crude hand-wiring and a general-purpose plug-in board. The display was a row of antique nixie tubes he must have had left over from his high-school-basement-lab days, because we sure don't stock them here. I saw him screwing it together in the office, getting his hands dirty and getting hair in his eyes and generally enjoying himself hugely. If he looked a little neurotic, I told myself, it was *my* kind of neurotic. I guess I look the same way when I'm puttering around my workbench at home.

We set the model up in the company cafeteria to see what kind of response it got, and we sure weren't disappointed. Even though the clumsy design of the thing obliged the user to transfer the results to a sheet of paper (we provided a pad of blanks) half the people in the plant trooped in to make up horoscopes for themselves. Truck-drivers came up from the loading docks to drink coffee and compare charts. The whole secretarial staff demanded and got the right to reschedule their vacations when the aspects were favorable. Marketing surreptitiously posted one of their people near the model to observe the reactions, and they say they learned a lot from it.

The daily conferences collapsed as far as any useful ideas went, while everybody compared charts. Bernie let himself be talked into reopening his classes to teach interpretation. I even found a copy of my own natal chart posted on my door one morning, and I have no idea who did it. I looked it over but it didn't mean anything to me.

By this time, of course, our security was shot to hell, but we decided we were far enough ahead of the competition that it didn't matter. We even sent some notices around to a few of the trade journals. That's when we started to get some feedback; among other responses, the student I-triple-E chapter at Rensselaer sent us a bomb threat—I guess they're a little excitable there.

I also found a note in my mailbox a few days after the newspapers picked up the story, on the stationery of one of the local fundamentalist churches.

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IT'S IGNORAMUSES LIKE YOU THAT CAUSE GOD TROUBLE, the note said. *YOUR NOT SO SMART.*

I happened to be passing Davis's cubicle one day and noticed a few gray-covered professional journals on his desk, of the sort everybody gets here every month. But I didn't recognize the titles. When I looked more closely, I saw that they were professional astrologer's association journals.

The photomasks for infusing the sapphire and silicon of the chips are a fascinating piece of art. They're drawn on oversize computer plotters, as painstaking and flawless and intricate as the vellum scrolls monks illuminated in the Middle Ages. When the masks came back, my shop's part of the job was essentially finished. We turned the masks over to the production team that would actually make the chips, and went back to other work.

Bernie remained on the floor to finish writing the user's handbook. The book was going to be something special: with everything that had to go in it (and Bernie told me he simplified everything outrageously even so) it made a thick volume. In keeping with the medieval name of the calculator, marketing had thought it would be cute to bind the handbook in soft leather. Then they planned to send the books to somebody in San Francisco who would give the covers an aged appearance by flailing away at them with chains. Very impressive, I guess.

I noticed a change in the nightly discussions Bernie and Davis were still having. Before, Davis had gone to Bernie, like a student seeking instruction. Now Bernie was coming to him, and even without eavesdropping you could hear that the tone of the talk had changed: Bernie was trying very hard to talk Davis *out* of something, I think.

Sally called me out into the corridor one day, to the big picture-window we have that looks down on the factory floor. We use it to razzle-dazzle visitors. She pointed down, and I could see Bernie and Davis just entering the "clean space". They were zipping up the hoods of their required anticontamination suits, white nylon coveralls that extend from the soles of the shoes to cover everything but the eyes. Davis was waving his arms around at the evaporators, ovens, microscope stations, and tiny diamond saws we use to separate chips from the larger wafers: it makes a very impressive show.

"Bernie wanted the Cook's tour," Sally remarked. "They look like pilgrims on the road to Mecca, don't they?"

"Aren't they?"

The change to an electrochromic display I'd been able to make on my own authority. That 'equal-house' problem I solved by ignoring it: as Sally said, "I've come to the conclusion it'll play about as well in Peoria one way as the other." But when Davis came to me with a new enthusiasm after the Engine had left our shop, I had to go

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to the head office to effect the change.

I suppose any manager would be alerted by sullenness or anger in his staff. I was just learning to be suspicious of cheerful energy, too.

"It's easy to put in," Davis said, "and cheap, too, for that matter. We'll just wire in an ordinary timer circuit, same as we sell to watchmakers. The keyboard is no problem, 'cause we've got an empty key position left over anyway. No basic modifications at all—and it's a great improvement in usefulness. With the extremely low power display, the user can just turn on the watch and get a continuous, real-time display of planetary positions. In fact, he can just leave it on all day."

"Sounds like it might be a good gimmick," I said casually. Davis was turning out to be a real spark plug on this project. Looking back, I think I'd describe it now as a headlong plunge into self-destruction. I suppose both descriptions are equally good.

"It'll be invaluable. Before this, nobody's ever had a way to continuously study the planetary aspects and draw guidance from them at every point. This will really help people to discover and use the influences in their lives."

"Davis, you're crazy. You know that? You're really crazy."

He bowed his head and looked abashed. "Oh, hell, Gordo. I don't really believe in this stuff. I'm just trying to get into the spirit of it, to get the work done better."

"Goddamn it, *don't* get the spirit. Our job is finished here. It's time to get into something else."

"You won't bring the idea up?"

"Oh, I suppose I'll take it in to the Board. I've got an obligation to the company. But, see here—has Sally tried to talk you out of this infatuation?"

"Yeah. Gordon, do I tell you how to run your life?"

"Every chance you get."

He began to get mad. "Gordon, you've got no call to be so stiff-necked and self-righteous. Astrology has been part of the human experience for thousands of years now, and it deserves at least your careful attention."

"GodDAMN it!" I spun around in my swivel chair and slammed my fist into the wall. It's a bad habit I've had for years.

Davis looked shocked and contrite. "Hey, Gordo, don't do things like that. If you'd just learn to express your anger instead of bottling it up with all your other emotions . . ."

"Shut up," I said, wincing with the pain. "I don't want to lose these emotions—they're the only goddamn emotions I have."

The next day Bernie burst into my office and threw himself into a chair, red-faced and breathing heavily. I'd never seen him angry before.

"Sit down and take it easy," I told him. "Coffee?"

"No. Gordo, has Davis been in to talk to you about that idea of his?"

"Yesterday, in fact. The head office likes it, so I guess they'll start crank-

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ing up for it pretty soon."

"Gordo," he said with exasperated, careful enunciation, "why don't you come to *me* to find out about astrology? What the hell is Davis doing to this project?" His anger drained out into melancholy, and he picked a styrofoam cup out of the wastebasket and began moodily to pick it apart. "You should have asked me, that's all," he said wearily.

"It's not a good idea?"

"It's a loathesome idea. I don't know, I suppose I should have known something like this would come up . . . I've got Davis's chart, after all."

"Hmm?"

"Well, if nothing else, Saturn is transiting his natal Saturn in Cancer right now, which is bound to intensify any latent weakness in his makeup, and it's badly afflicted in relation to his natal Moon . . ." he broke off when he caught sight of my expression, and surprised me by grinning goodnaturedly. "OK, OK. Let's see if I can put it in terms you can accept. Has Davis talked to you about opening up your feelings and expressing your emotions and such stuff?"

"Sure. He gives that same rap to everybody."

"Don't I know it! Would you believe me if I told you that whole line is phony?"

"He seems," I said, "to be pretty sincere. Too sincere, for my tastes."

Bernie shook his head. "Not when you look at it with the tools my art gives me. Gordon, Davis *hates* his emotions, every one of them. He's frightened by anger, and embarrassed by love, and ashamed of resentment and everything else. He was talking to me about his school days back in Caltech—he was pretty introverted and shy, right?"

"Well," I said cautiously, "a lot of us were at that age. Most of the students in my class were the same way."

"But I think Davis found another way to deny himself. What he wants to do is diffuse his feelings, since he can't handle them, and bring them out in the air and release them before they grow large and strong enough to affect him, so to speak. He wants to keep his emotions down on this piddling infantile level they encourage at these human-potentials things he goes to, so they don't threaten him. Gordo, all Davis really wants is somebody to tell him what to do. That's really what he wants from astrology."

"So you've got a convert then, right?"

"Spare me. That real-time display he wants—Gordo, there is a kind of astrology that deals with that kind of information. It's called horary astrology, and it teaches a way to derive guidance from the position of the heavens at the moment. But it's hellishly difficult! I've been studying this science all my adult life and I don't feel qualified to practice it. I don't think there are two dozen astrologers in the country who are. And yet Davis thinks that silly plastic numberer is going to take his life and run it for him."

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He stood up and began to pace back and forth. "Gordon, astrology isn't meant to tell people what to do. It's a way of clarifying and illuminating the choices available, of pointing out the best paths among competing opportunities. It helps a man to realize what he wants and then helps him attain it. It's a way of becoming more fully human."

"Want to know a secret?" I asked from my chair. "That's what engineering is all about too."

"But Davis is abusing it! He's taking all the good gifts my art has to bring and perverting them in a way they were never meant to be used."

I couldn't think of a thing in the world except, *you too?* "Welcome to the club," I finally said.

We started having oddly erratic patterns of sick days at work. I asked Bernie to look into it, and he confirmed my suspicions: half of my work force was keeping an eye out for badly aspected days.

The day they finally put the Astrological Engine into production was one of the days Davis arrived early and eager for work. No coincidence: the engineers in charge of production had consulted the same charts Davis had. Sally brought me one of the finished models. "Notice the little loops on the top?" she asked. "The final design was so light we decided to cash in on the astrological jewelry market too. You can hang it around your neck."

"Very appropriate," I said sourly. I turned the thing over in my hands, poked experimentally at a few of the buttons. "I suppose everybody's got one by this time?"

"Just about. Bernie didn't show up to get one, though." Davis came in the door from the hallway. The calculator was hung around his neck and he was holding it in one hand, frowning over the display. He walked with a distracted air, threading his way through the desks, lost in concentration. He disappeared into his cubicle.

Sally asked quietly, "How is Davis's work going?"

"As well as ever. He likes his work. But he's getting awfully hard to talk to these days."

"Gordon, don't worry about Davis. I talked to him, you talked to him, so did Bernie, and even his wife has had second thoughts about this. We all tried our best to reach him, you know we did."

Another person walked in, telling the buttons on his calculator like prayer beads. "How many more Davises are we going to make?" I asked.

"Don't blame yourself. If it wasn't astrology, he'd be chasing after some guru."

"I'm sure you're right," I said. I grasped the Astrological Engine in the thumb and forefinger of each hand and cracked it cleanly down the middle.

"Come on," Sally said, taking the pieces from me and tossing them in the wastebasket. "Let's go get drunk or something." ■

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Even before the bulkship *Ceres* slid down the ways, she killed two men. A dockyard crane cable slipped, unloading steel plates on workmen at her bow.

During her first year at sea she added a third victim, via a sliced power cable on a wet deck. The Company felt lucky that the year's toll had not been higher. *Ceres* had survived a collision, an engine room fire, and an accidental discharge of CO_2.

The second year claimed the life of a cook lost overboard, an incident written off as par for the course. The Company was more concerned about the continual foul-ups of the ship's derricks and grabs.

The third year seemed uneventful until a routine insurance survey revealed a skeleton (male) in a ballast tank. Probably a stowaway who had squeezed into the temporarily unsecured deck hatch, not realizing the tank would be filled with water as soon as the ship was trimmed.

A horrible way to die, come to think of it.

griggs

and the Einstein fallacy

As Mussolini once said, a man of action can always find a philosopher to explain what he did.

Sam Nicholson

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Even while the survey was continuing in the Baltimore drydock, *Ceres'* bosun plunged from the dockyard catwalk. Broke every bone in his body, including his neck.

The crew walked off the ship, swearing "Jinx!"

At this point Mickleberry in Operations telephoned me on a chemical tanker loading liquid chlorine at Freeport, Texas, and ordered me back to New York.

I packed my suitcase, left the tanker in charge of my chief mate, got the ship's agent to drive me to the Houston airport and was in Mickleberry's office that same afternoon.

I sat down in the smooth-worn chair beside his desk, and he began, "Captain Schuster, we do not believe in jinxed ships."

I thought, uh-oh, I'm slated for *Ceres*. I said, "Well, you gotta admit that certain ships are accident-prone."

"A level-headed skipper could be a step in the right direction. *Ceres* has had six skippers in three years."

"Why have you taken Captain O'Neal off the ship? The skeleton was in the tank long before he came aboard. And why drag me into it? Scraping the bottom of the barrel, are you?"

Mickleberry puckered a smile at me. "Applying you to a problem, captain, is a case of the cure being worse than the disease. However, when Chief Mate Griggs notified us that the crew would go back to work under your command—"

"Griggs? You've got Tom Griggs on *Ceres*?"

"O'Neal asked for him, and we have left him aboard." Mickleberry cleared his throat. "Griggs is a very intelligent man."

"Yeah, and he's wasting his intelligence at sea. He should have quit years ago."

Mickleberry lowered his voice discreetly. "His unfortunate indebtedness to the Company—"

"His wife still has him in hock to the eyebrows, hey? Mink-mad Mary. How's young Tommy?"

Mickleberry brightened. "Quite well. The leukemia seems completely arrested. The boy is back in school."

"Fine." I smiled at the thought of Griggs Jr. and got back to *Ceres*. "What's Griggs up to now?"

"Pending the arrival of a new skipper he is commanding *Ceres*. He looks at the problem mathematically. E equals Schuster squared away."

"Nuts. Griggs just don't want a jinxed ship as his first command. I told you, the guy is smart."

"Captain, this irrational concept of a jinx—"

"Won't matter a hill of beans to me. I'll still run the ship my way, with no back talk from you or Griggs or the goddamned jinx. Is that clear?"

"Standard Schuster procedure," sighed Mickleberry. He ripped a page from his memo block and held the page out to me. "Your flight number to Baltimore. Pick up the ticket at the airline desk. Do you require expense money?"

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I rose, took the page and glanced at the flight time. "Not as long as I can catch the airport bus. I'll buy my own Scotch."

"The Baltimore agent will meet the plane. Good luck, captain."

Later that night I boarded *Ceres* in a Baltimore drydock, under the cold glare of work lights and welding torches. A seaman ran down the ladders of the access-staging to take my suitcase. Apparently Griggs had persuaded the crew to go back to work.

Griggs himself was on the top catwalk. Thirty-odd, well set up with finely-honed features and cool analytical eyes. He smiled, "Welcome aboard, captain!"

"Thanks, mister!" I barked. "But no thanks for passing the buck to me on this jinxed hooker!"

He laughed. I went on, "All the ship's papers are in your office, hey? Let's go there first."

Three years had worn the newness off, but the mate's quarters were roomy and comfortable. Taped to a bulkhead was the photo of a freckled-faced smart-looking kid. I asked, "How's the boy, Tom?" as I pulled off my coat and dumped myself on the settee.

"Recovered and holding steady, sir." He restrained his fatherly pride. "Scotch? There's no ice. The workmen have disconnected the refrigerating systems. Captain O'Neal ordered the checkup. Nobody has ever found the bugs."

"The real jinx of *Ceres* is the wiring," I commented. "That collision at sea was due to a fuse blackout. During maneuvering at close quarters the wheel went dead. And, of course, the derricks and grabs are always haywire."

Griggs took a bottle of Scotch and a glass from the locker. "The ship is out of phase."

"Out of phase with what?"

"You think relatively. Everybody does." Griggs set the Scotch and glass on the table in front of the settee. "It's the Einstein fallacy."

I poured a slug of Scotch, which I figured I would need if Griggs began upon Einstein. I am a low-velocity Newton man, myself.

"Einstein was concerned with the interaction of mathematically calculable phenomena within a specific time dimension," continued Griggs. "It was the How of the universe. A horizontal survey, in other words.

"Relativity is measurement, not causation. It is position, not meaning. It can explode the atom with poisonous fallout—but not unlock it harmlessly. It cannot explain the Why of gravitational fields or electromagnetic energy. It does not touch the inherent nonrelative qualities of phenomena. It makes no vertical survey."

"Yeah, but the Why of phenomena is way over our heads, Tom," I objected. "Who can hope to know the Why of gravity?"

"All of us, sir, if we can free ourselves from the How of Relativity. Things exist in-and-for themselves, not only as observed in relation to the

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rest of the universe. They exist, for example, in independent relation to Time.

"If we look beyond mass-velocity concepts, we find that Time has two corollary aspects. First, the universal all-points-contiguous post-Euclid configuration of past-present-future—a general field which is the background fabric of mass-energy movement, but which I will not discuss now—"

I thought, thank God for small favors.

"—and second, the aspect we call timing, which is the integration of each individual phenomenon into the general time field. It is a vertical function. The horizontal Relativity survey ignores it—and in so doing, distorts the shape and functions of the general field.

"Captain, *Ceres* is jinxed because something went wrong with her timing. That's why her electrical systems don't work properly and her human element always feels disoriented. But, I believe, by tight and constant control of all systems, we can warp her into shape again."

"You may be right, Tom, but my functions are neither horizontal or vertical. Just pragmatic. Forget the How and Why. A jinxed ship is like a lemon car. We're stuck with her until the Company scraps her."

Griggs stopped theorizing and handed me the dockyard estimates, Captain O'Neal's last reports, *Ceres'* grain charter and the Crew List. I asked Griggs, "How did you sell the crew on coming back to work? You didn't promise them anything in my name, did you?"

"No, sir," he smiled. "They agreed that having you aboard was fighting fire with fire."

I considered. I really respected Griggs's brains, and he had given some practical advice. Tight and constant control. The wiring foul-ups aside, most of the jinx items were what I would call carelessness and sloppiness. No cooks fell overboard from ships I commanded, and no stowaways found unsecured tank hatches at their disposal. I said, "Can we persuade the crew that the jinx can be licked with hard work?"

"Why not? Most people understand the fluid nature of all phenomena. That's why they always hope. That's why it's always a new ball game. The constant movement of particles is an observed fact on the horizontal Relativity plane. Change must also be immanent in the Vertical Causation line."

He continued earnestly, "Think of ships as clay vessels from a potter's wheel in an aboriginal village. Most of the vessels turn out okay, but one like *Ceres* is lopsided. The aborigines, seeing only the behavorial How aspect, say the vessel is bewitched.

"But one aborigine, without being interested in the Causative Why of the potter's wheel, might take that lopsided vessel and mold it in his hands until it was straight."

"You're assuming the clay was still unfired and malleable."

"Yes, sir. The total mass-energy

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field of any phenomenon is fluid and malleable. *Ceres* is steel, true, but the steel is only seemingly solid and is not the total field. The fact that the navigation officers, regardless of modern instruments, most constantly check the compasses for deviation and variation, proves the far greater importance of the electromagnetic fields within which the ship operates.

"At the time *Ceres'* keel was laid, there was a malfunction in that electromagnetic environment. Since we are aborigines in the Why calculation, we have no understanding of the problem. We can say only that the ship is jinxed."

He tapped the grain charter. "But during this voyage we can mold our vessel and warp our timing into the general time field."

I looked the charter over and remarked, "A cargo for Belfast, hey? Northern Ireland is not a destination I would choose for a jinxed ship."

He smiled again. "Well, the IRA has not yet bombed the waterfront."

"Yeah, that's what I mean."

The next morning the repair work was finished, the shipyard refloated *Ceres* and we moved to a Baltimore grain dock. Knowing that Griggs could handle the grain tonnage the conveyors were shooting down into our holds, I turned my attention to the ship's other departments. The chief engineer and chief steward were capable men but admittedly ready to declare the ship a disaster.

"Not a goddamned thing works the way it should," complained Chief Engineer Hazeltine. "O'Neal said he was glad to get off the ship."

"Let's keep ahead of the breakdowns by constant checking and renewal," I said. "It'll cost overtime, but we'll spot a good percentage of the trouble before it peaks."

"What's the checkup area?"

"The total mass-energy field. From the main engine to the lifeboat motors—"

"Both lifeboats have brand-new marine diesels. Mickleberry threw a fit, but no crew would sign aboard *Ceres* unless they figured they could get away from her fast."

"Brand-new or not, check them. I want you and Griggs to keep tight control of all systems."

"All?"

"From the water condensing unit to the iron cow. From the radar mast to the emergency lanterns under the fo'c'sle. Every inch of mooring line, every foot of deckplate—"

"Mickleberry will have a stroke."

"All he can do is fire me, and I've been through that routine before."

Hazeltine, who knew me pretty well, glinted a look at me. "Why the sure-bet attitude? Changed your brand of Scotch, or what?"

"Griggs has found an Einstein loophole you can drive *Nimitz* through. Relativity is only half the answer—and the noncausative half, at that. We can take *Ceres* as she is, a malleable mass-energy field relative to nothing but herself, and mold the jinx out of her. We'll shape her up like the Fat Lady in a new corset."

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"Yeah, it's the Scotch," muttered Hazeltine. "Hard-headed Schuster has cracked at last."

All the same, the jinx-shadow was off his face. I had given him a new angle to think about.

Modern conveyors fill a grain ship in a hurry. By mid-afternoon we were settling down on our marks. I was working in my office, waiting for Griggs to notify me that the loading was finished. There was a tap at the opened door.

I glanced up to see a sharply-dressed young man with blue-black hair, blue eyes and a tightly-wound expression. He said, "Captain, may I have a moment of your time? Your ship could be a godsend, if she's going where the shipping news states. My name is Cullane—"

He advanced to the desk and handed me a business card. I took it and read,

MORTON-LAND TOOL & DIE

Alex Cullane

Sales Rep.

He went on, "We have six crates of machine parts to be rushed to a customer in Belfast. It would be saving us the delay of transshipment or the expense of air freight if you would be taking the crates aboard. As deck cargo, maybe."

The pitch was as phony as a three-dollar bill. I had no time for a hassle, but I wanted to find out what the guy's racket was. I said, "What size crates? We're exclusively a grain carrier. Stowing deck cargo according to safety regulations would mean extra work that I would not authorize without urgent reason."

His voice became confidential. The hint of Irish brogue broadened. "Then I'll be putting me cards on the table. Why should there be reservations between meself and Captain Patrick O'Neal?"

I was silent. Not so much from guile as from sheer disbelief that a guy named Schuster could have a map of Ireland on his face.

Cullane continued, "We have a great gathering of Irish-American patriots. The names I could name, that are backing us! Sure and you yourself, Patrick O'Neal are an Irishman born and bred, with memories of the bloody tyranny of Cromwell.

"But I wouldn't be asking you to help us from patriotism alone. There's money to be made in running guns into Ulster, and why shouldn't you get your share of it? Just to smuggle six crates past the British—"

Another tap at the opened door. It was Griggs in a grain-dusty boiler suit, a small memo paper in his hand. I nodded him to speak, and he began, "Captain Schuster, here's—"

Cullane drew a breath and stared at me. His glance shifted to the business card I was still holding. He had made a bad mistake, and shiny paper holds fingerprints.

I dropped the card briskly into the top drawer of the desk, shut the drawer decisively and said, "Sorry, but no deal, Mr. Cullane."

He turned around and beat it fast. Griggs looked at me uncertainly. I

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asked him, "Why—at that time of all times—did you address me by name, Tom?"

"I don't really know, sir," he answered, puzzled. "I was going to say, 'the draft figures, captain,' but when I saw the visitor, your name slipped out."

"It would, on a jinxed ship. The human element was sure out of phase in that minute! A few more seconds of him thinking I was Pat O'Neal, and I would have conned those crates out of him."

"What crates, sir?"

"Guns for the IRA. Get on the shore phone and tell the FBI we have information for them if they can send an agent here before we sail."

Griggs raced below on the double.

The FBI were prompt. A granite-faced gray-suited agent was on board in twenty minutes. I had not realized Baltimore was an IRA-sensitive area. I gave the agent Cullane's card and told him the whole story. I finished, "Now don't send your cloak-and-dagger boys after Captain Pat O'Neal. He has no connection whatsoever with IRA gunrunning. The gang undoubtedly saw his name in the newpapers. God knows there has been enough publicity about *Ceres'* drydock troubles. These mercenary shamrocks remembered the Irish captain when they saw in the morning paper that *Ceres* was loading for Belfast.

"I would have tried to con more information out of Cullane," I added, "but the mate came and inadvertently blew the gaff."

"Bad luck," commented the agent.

"Bad luck is the only kind we have on board," I told him.

The incident loomed larger than normal in my mind because it seemed to imply that the jinx was psychic instead of electromagnetic. I said as much to Griggs later, on the bridge.

We had dropped the pilot. Griggs had the bridge watch. He looked speculatively into the night-clouded east.

"I don't dismiss psychic force from the mass-energy picture," he said slowly. "There's too much empirical proof for extrasensory phenomena. But the Cullane incident is a common example of mistiming, like a car engine sparking too soon or too late."

"You don't believe somebody cursed the ship?"

"If it is possible to cause malfunction by psychic or psionic force—and there seems to be some evidence for the latter—the malfunction would necessarily be remolded as the total field was warped into phase. Besides, there has never been proof that anybody cursed *Ceres* or the Company. Why would they? As companies go, it's decent enough."

I thought of the large debt the Company was carrying for Griggs, and I said no more.

All hands turned to with a will on our beat-the-jinx tune-ups. There was good sense in what Griggs had said about remolding. A jinx can only work on the material at hand. If all systems are relentlessly kept in optimum running order, the jinx is stymied.

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Hazeltine's engine room gang had the most work, of course. After several days at sea he told me he could do no more checking without shutting down the main engine. The weather being favorable I told him to shut her down, and we coasted eastwards with the breeze and current.

As I sent off the noon position I wondered how Mickleberry would react to the decreased distance covered during the eight hours of drifting.

To judge from the coded message the radio officer handed me the next afternoon, Mickleberry blew his stack. The results of our work would have to be quick and convincing, if I was not to become the seventh skipper fired from *Ceres*.

The message had come during Griggs's watch. I went out to the bridge to tell him about Mickleberry's blast. He said, "The ship's morale couldn't be higher, captain, and morale is a significant factor. A jinx is a feedback mechanism. A man can be so preoccupied by impending doom that he trips over his own feet."

Assuming we had the morale and the physical plant under control, what about the rest of what Griggs would call the electromagnetic environment? What about the weather and the sea?

The wind had been kicking up. I watched the forward deck corkscrewing through the swell. Grain was a shifty cargo at best.

But, as events turned out, I was worrying about the wrong factor.

As Griggs and I were talking, the radio officer came into the wheelhouse. He stopped short at seeing me and said, "Excuse me, captain—"

I nodded and he turned to Griggs. "Tom, your wife is on the phone."

I spoke up at once. "Take the call, Tom. I'll stand watch."

He thanked me and followed the radio officer from the wheelhouse. I felt a twinge of impending doom, myself. Mink-mad Mary was always bad news.

I ambled out to the bridge wing. In a couple minutes Griggs came out to me. He looked as if he had taken a low blow and was about to go down for the count. I asked, "Is something wrong with Tommy?"

"No—no, the boy is fine, sir. It's just that I have to ask you to authorize another salary advance. Mary needs a thousand dollars. She let a department store account ride too long—"

"You've got to put a reef in her sails," I told him.

"I can't—not without having the withdrawal go out over Tommy. Mary's psychiatrist says compulsive spending is a sickness, like alcoholism or gambling. She's got to be handled with kid gloves."

That was not how I would have handled her, but I kept my mouth shut. We watched a wave explode at the bow. Water flooded the low-riding deck and cascaded over the scuppers.

Griggs burst out, "But, honestly, captain, I don't think Mary is sick. I think she's resentful about my working at sea—not that she ever gives me

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a breathing space to pay my debts and look for other work. I think she's punishing me, and I know she's socking away most of her allotment and making me find the money for these credit purchases.

"If I fell off a catwalk and broke my neck, she'd be satisfied and live an easy life on the double indemnity insurance. She'd make a dime go even farther than Mickleberry."

The woman was a cold greedy bitch. If Griggs died, she would find another damned fool and drain his blood, too.

I said only, "I'll authorize the salary advance. Don't worry, Tom," and I went to my quarters. It was Griggs's problem, not mine.

Or was it? *If I fell off a catwalk . . .* They were not words to say on a jinxed ship. So help me, a chill ran along my spine when I thought of them.

We had normally gusty weather until the approaches to Belfast Lough. The wind died, the sea smoothed, and dense fog muffled us up in the Lough like damp lamb's wool.

We inched into the position assigned us by the pilot station, dropped the hook, shut down the engine and waited.

I did not like that fog, although I had no reason to be leery. We had arrived unjinxed where we were going, and everybody was glad about it. Of course, the guys were straining at the leash to go ashore, and they were beefing because the mail would be delayed in coming aboard, but generally the tension relaxed.

The next morning the fog was still dense. With the main engine shut down, the silent hollow-sounding ship got on my nerves. I cleared away some paperwork and typed up my Voyage Report, leaving it in the typewriter until we would dock.

About 1030 hours the desk phone rang. It was the third mate, who had the bridge watch. He said hesitantly, "You wanted a report on any unusual occurrence, captain. Well, there's the damnedest hide-and-seek on the radar screen—"

I dropped everything and beat it to the bridge.

The fog was so thick I could not see the bow from the wheelhouse windows. From the bridge VHF came the voices of arriving skippers calling the pilot station.

The third mate moved away from the radar, and I stared into the screen. In the wide corridor of the Lough, the sweep blipped a pattern of anchored ships. A smaller vessel was cutting an arc through the pattern with proper caution in the fog.

The arc altered course. A still-smaller blip shot away from the lee of an anchored ship, as if trying to keep that barrier between herself and the searcher's radar.

"You know, captain," mused the third mate, "I'm beginning to understand what Griggs means when he says all the bridge instruments are How-oriented. This radar tells How that cops-and-robbers chase is mov-

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ing, relative to us and to the other ships. But it does not tell Why the chase is edging toward us."

I said absently, "Why is a different dimension."

"When a guy is a sitting duck on an anchored ship—and a jinxed ship, at that—the Why dimension is the important one. Matter of fact, it's always the important one. Where's the sense to measuring How things act, unless you can find out the reason behind them?"

As I watched the zigzag course of the smaller boat dart nearer, I shared his preference for vertical Causation instead of horizontal Relativity. For inherent meaning instead of relative position. Was the boat darting randomly to escape from a patrol, or was she coming as a threat to us? Who on Earth would be a threat to us?

My brain must have shifted into the right gear, because the answer came in a flash. Cullane. Had the FBI nabbed him through the information I had given them? If so, Schuster was now on the same blacklist as Cromwell, on both sides of the Atlantic. And when those IRA hotheads got sore, they said it with bombs.

If they had a fast radar-equipped cruiser and had heard over the VHF where *Ceres* had been advised to anchor, they might come out and throw a bomb at us, counting on escaping in the explosion and fog.

Sitting duck was the word for us, all right. I went to the bridge telephone and called Griggs's quarters. He answered and I said, "Mayday, Tom. The IRA in a fast cruiser. Lower both boats and find a couple volunteers to set up a roadblock."

"I'll take one boat myself. What's the play?"

"Block them and duck. They have a patrol boat on their tail. I wouldn't set you guys up unless I figured the British were coming."

"Let's hope they're not too little and too late."

In ninety seconds the lifeboats were lowered and lying alongside. Griggs, with a walkie-talkie, was in the starboard boat. The life-jacketed second engineer was in the port boat, which he had brought around to join Griggs. Life jacket. Had Griggs forgotten his?

The stalking in the fog-stuffed Lough continued on the radar screen. It was obvious now that the small cruiser had no other purpose than to reach us. I thought, the stubborn Irish. At last they seemed to say to hell with dodging the patrol boat, and they came toward us like a torpedo.

I grabbed my walkie-talkie and said to Griggs, "The enemy is two points off the starboard bow and coming fast."

"Right, sir!"

I went to the bridge wing and watched the lifeboats start up and glide forward into the fog, with Griggs's boat in the lead.

Back to the radar, now switched from the general Lough-scan to the immediate range. Griggs was on a collision course with the cruiser. The fast craft swerved. Griggs countered.

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The craft circled completely around, showing her heels to the slower lifeboat.

Bypassing Griggs she resumed course—and was blocked by our second boat. Another evasive swing.

The radar went black.

I roared a curse that must have blistered all How and Why dimensions, and I barged out of the wheelhouse. I jumped down the ladders and lumbered along the forward deck to the bow.

Through the mist I could see that the fast end-around rushing had brought the play to our twenty-yard line. The attacker was a flying-bridge cabin cruiser, far outclassing our dories. There was no way our slower boats could block her swivel-hipped ground-gaining.

Griggs suddenly charged full speed toward her. I saw that he meant to ram.

Those were not my orders. I had told him to block, not to commit suicide by ramming a craft which undoubtedly had high explosives aboard.

Suicide. *If I fell off a catwalk . . . the double-indemnity insurance . . .*

The heartsick fool was going to add another death to *Ceres'* score. He was going to wreck our beat-the-jinx campaign. I roared, "Stop!"

He could not hear, of course. He swung to shortcut across the cruiser's evasive turn. Just before the lifeboat's bow rammed her midships, he dove into the sea.

He surfaced and struck out for our other boat, which I could make out dimly off the port bow.

The cabin cruiser blew to glory. The bomb they had intended to lob against *Ceres'* waterline must have been a lulu. I saw the man on the flying bridge flap into the air like a rag doll and come down near Griggs in a shower of debris.

Griggs was hit. He sank and did not come up.

I ripped off my wool jacket, vaulted over the rail and splashed feet first into the drink. I thought, Mary has broken Tom down until he doesn't care if he lives or dies.

I lunged toward him underwater, grabbed him, bulled our way to the surface and held his chin clear of the water.

Something hit me weakly on the back. I looked around and saw the disjointed but still-living rag doll from the cruiser. His eyes stared from their sockets as he flailed helpless limbs to clutch me.

I brought my arm out of the water and chopped a blow into his neck. He sank like a stone.

Griggs had been hit on his left shoulder and arm. Probably his ribs, too. He opened his eyes. They were still cool but very tired.

"Never mind," he coughed, and a pale blood bubble wheezed through his nose.

"Mind!" I yelled. "We had a jinx licked, and you tried that damnfool stunt! Shut up and live! Live for the ship! Live for Tommy! Damnitall, live for Tommy!"

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His eyes showed warmth and interest. I could see strength come into his face despite the dribbling bubbles.

The second engineer was maneuvering his boat alongside us, but a white hull slid out of the fog and walled us on the other side. A clipped accent called down, "Ahoy! You chaps need assistance?"

I looked up into a spade-cut beard and braided cap. I barked, "My mate is badly hurt. Can you rush him to a hospital?"

Well, the British were not too little or too late. They hoisted Griggs aboard and shoved off fast, pausing only to put an Intelligence officer into our lifeboat to get the story. A quiet clerklike guy who I found was named Dunning, when we had time for details.

Dunning and the second engineer hauled me into the lifeboat and took me to *Ceres*. I climbed aboard by the pilot ladder. The lifeboat, under Dunning's direction, returned to fish up identifiable pieces of the cruiser.

By the time I had changed to dry clothes and given the radio officer a message about Griggs for the Belfast agent, the lifeboat was being winched aboard. Dunning came to my quarters. I ordered a tray of coffee and gave what I thought was a clear account.

Dunning did not seem to know what the hell I was talking about. "You have said, captain, you had no prior expectation of an attack. Yet you had alerted your watch officers, and you took immediate steps when the blips appeared on the radar."

"Yes, but that was just part of the beat-the-jinx tune-up," I explained carefully. "The ship's timing was off. That is, her mass-energy field was out of phase with the universal time field."

"I see. Quite."

"No, you don't see. I don't see, either, because Griggs did not waste time trying to get post-Euclid theorems into my thick skull. But he gave me some practical advice. By forcing the ship's systems into a straitjacket of absolute control, we could bring the ship into phase. Like adjusting the spark on a car motor."

"But, according to your account, the radar went black. So the ship is still jinxed."

"To the contrary, when I got to the ship's bow I realized our timing was okay."

Well, I could not get through to him. He dropped the subject and asked if I had seen the men aboard the cruiser. I said I had seen only the one who had been blown off. I added, "He was interfering with my rescue of Griggs, so I clobbered him. He was far gone anyhow."

Dunning's puzzlement increased. "My word, captain! Did you kill a dying man? A man who was no serious threat to you?"

It was then I felt the shock of how far astray Relativity had led the world's values. All measurement—and no meaning. Nothing was evil, nothing was good. Everything was relative. I said to Dunning, "I was not working on the Relativity plane. I was

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not measuring How the man was, relative to health, relative to me. Inherently he was a vicious murderer. He was a malfunctioning psychic entity, and I scrapped him."

"I understand your attitude—I think—but I advise you to modify the incident when you make your official report."

I had to admit the guy had something there.

The patrol boat took Dunning off *Ceres* shortly after noon. I suspended my Relativity arguments and got back to work. I went to Griggs's quarters and packed his suitcase, so the ship's agent could take it ashore. I did not forget the photo of Tommy.

When we docked the next day and the mail came aboard, I had a letter from Mickleberry:

Please be advised that the FBI have apprehended the man named Cullane who attempted to ship six crates of weapons aboard Ceres. *He has uttered threats, so I further advise that you be alert for reprisals from his Belfast organization.*

Tightwad Mickleberry could unlimber his telex for a beef about an eight-hour engine stop, but a terrorist threat to the ship was worth only a postage stamp.

Well, that about concluded the excitement of the voyage. We were lucky enough to replace the blown-up lifeboat. In disordered Ulster, that was really luck.

I went ashore to visit Griggs in the hospital. He was doing fine, minus two crushed ribs and with his arm in a cast. The hospital planned to repatriate him by air the next week. He was back on even keel again, his depression having worked itself out.

After the grain was discharged we had an uneventful voyage back to Baltimore. And who should traipse on board after we had docked, but Mickleberry!

He came into my office and remarked wryly, "I expected to find the decks paved with gold, captain, after the expense of this voyage."

While he sat and griped I mixed him a martini, took a Scotch for myself and said, "You put me aboard to unjinx the ship and I did so, thanks to Griggs and his Einstein fallacy. The job cost money, but *Ceres* will never again cost a life."

"Why do you reach that conclusion?"

"Because the radar went black, sending me to the bow where I was right at hand when Griggs went under. Instead of being killed by a jinx, Griggs was saved by a miracle. In the Why dimension—which is the operative dimension—that means all systems are go."

Mickleberry swished his drink. I added, "How is Griggs?"

"Recovering fast. We are thinking of giving him command of *Ceres* when he is medically fit."

"Good idea." I paused. "But what are you gonna do with the Old Man?"

He puckered another smile. "Don't worry, captain. We'll think of something." ■

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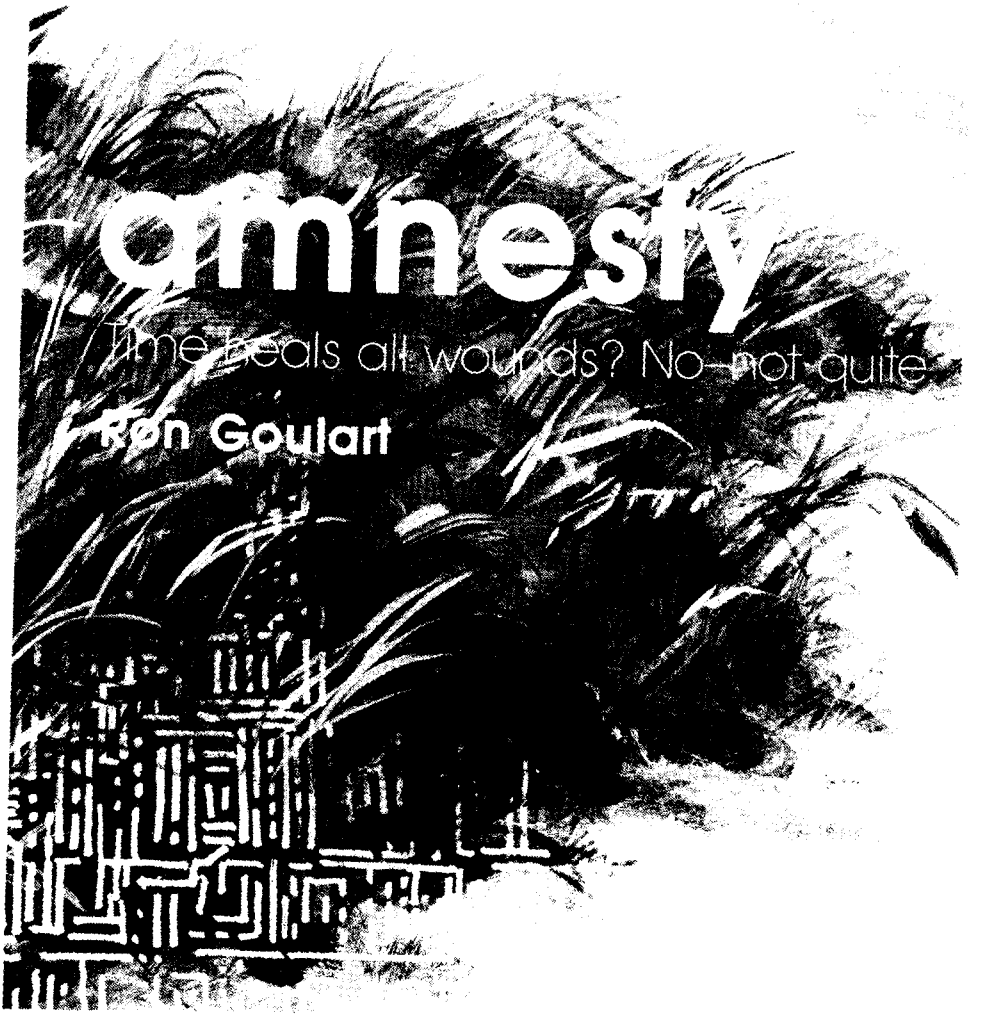

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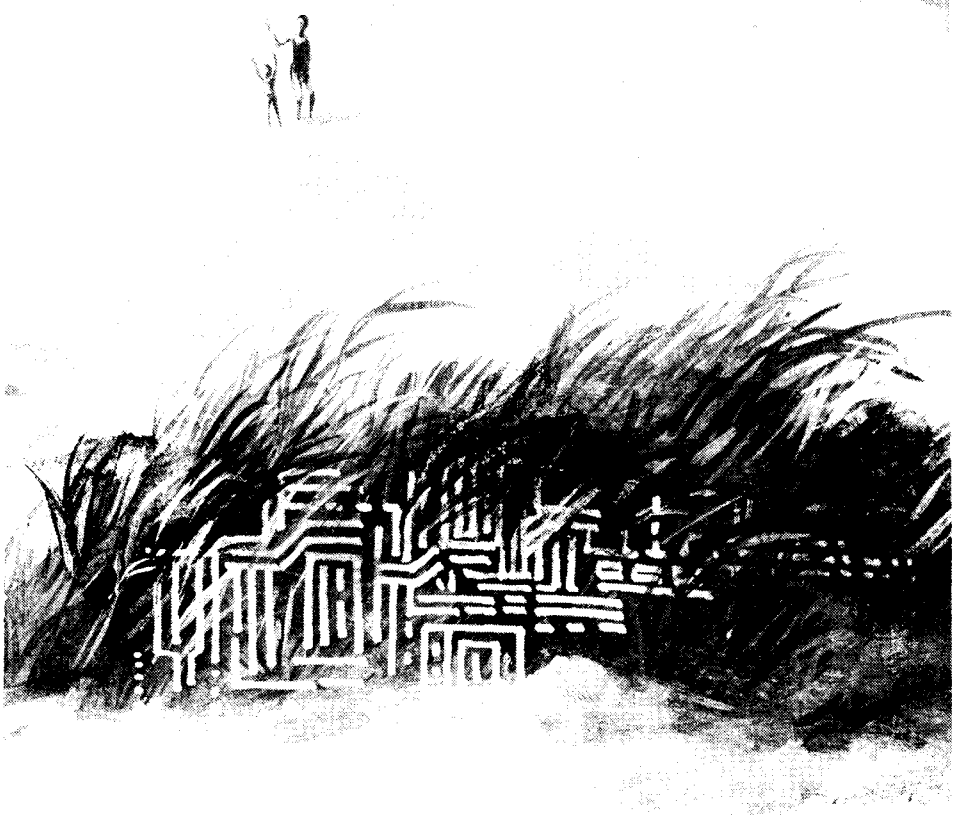

JACK GAUGHAN

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The robot shook its head. The shaking made a white blur in the shadows above the small bed. "I'm afraid," it said, mouth-hole vibrating, "there's no hope." Its metal fingers detached themselves from the small girl's wrist.

Nat Sellek stayed on the other side of the child's dimmed bedroom. "I don't believe you."

"No hope," repeated the medical robot. "Only a matter of minutes, Mr. Sellek."

Outside the dimmed windows it was bright hot afternoon; the glaring Pacific would make your eyes slit, the sand burn your feet. Sellek shivered, but made no move. "She's not going to die."

"You must try," the white robot advised in its croaky, quivering voice, "to accept it."

The yellow-haired girl, face dug deep with shadows, stirred. "Daddy," she said in a faraway voice, eyes not opening. "Daddy."

Sellek bit down on his lower lip, breathing in slow snorts through his nose. "All right, all right, damn it." He bounded across the room, pushed at the robot. "Get away from her."

The little girl lifted one thin hand. "Daddy."

"You're going to be OK, Mary Liz." Sellek hesitated, then knelt. "You're only four, you're going to be fine." He caught her hand, squeezed. The fingers were cold and moist.

"It's not wise to give false hope, Mr. Sellek," cautioned the robot. "Wiser by far to prepare the child for—"

"Shut up. God damn you. Just shut up!"

"Raising your voice at such—"

"Get away, get the hell away." Letting go of his daughter's hand, Sellek stood and shoved both palms hard against the robot's white enamel chest. "Do you hear me? Get away!"

"Daddy." The small voice was even more distant now.

On his knees, Sellek took the cold hand gently up. "I'm here, Mary Liz. You'll be all right. Four years is such a small piece of life to have. We'll be doing all . . ."

The little hand dropped out of his grasp, as though the wasted child were sinking down away from him.

"All over," said the robot.

"No, I don't believe it. She's not dead."

She was so still, so small and still.

Sellek fought against it, but he started to cry. "Mary Liz," he said to the dead child. "You're the only thing that makes it work. You can't—"

Then the laughter started again.

The familiar laughter, nasal and harsh. It filled the shadowed bedroom, pushed against the walls, and the edges of things began to blur. The walls, the dimmed windows with the muted view of the yellow beach and the bright ocean, all began to spill away. Last of all the bed with the body of his dead daughter on it.

The pain followed.

The wires being detached.

No shadows, no windows. The smooth metallic walls of his cell were around him now.

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The laughter sputtered down, diminishing.

"Really had you that time," said Hernandez, the last chunks of laughter falling from his thin dark lips. "Down on your knees praying, were you? And crying, tears streaming out of your eyes. Absolutely marvelous. 'Please, lord, don't take my little baby from me.' Oh, truly splendid, Sellek." He laughed some more, rocking in his lucite chair.

"It wasn't real." Sellek, stumbling, dropped into the cell's other chair. "I was almost certain it wasn't real, but when she called to me . . . Jesus."

"Perhaps," suggested Hernandez, "it's truer than you think."

"What do you mean?"

Hernandez twisted an electric pen out of the breast pocket of his gray tunic. "Ready to discuss things, Sellek?"

"Mary Liz, she's not really sick?" For the first time since the illusion had ended he glanced over at the chunky black machine to which he'd been attached. The wires that had been hooked to him dangled down its front, like spilled entrails. "She's not really sick?"

"Yes, she's dying of a rare and incurable disease," Hernandez told him.

"You bastard!" Sellek left the chair, dived toward the other man.

Casually, Hernandez swung his stunrod.

The shock tossed Sellek back to his chair. "She's not really ill," he said, shaking his head. "You're just—"

"Torturing you?" Hernandez laughed. "Yes, of course. Actually the little angel's in wonderful shape, exactly as she was when you last saw her. When was that, by the way, Sellek?"

Sellek rubbed his palm across the back of his neck, massaging one of the attachment points. "Six months," he answered finally.

"Really? The child's made incredible progress then. In Form 2 and only four and a half years old. Inherited her intelligence from you no—"

"All right, OK. I don't know how long it's been. You keep hooking me up to that damn box . . . How long was I hooked up this time?"

"An hour."

"Was that all?"

"Actually it was six hours."

"Nope, not that long, even though it seemed like an actual week of time."

"It was," said Hernandez. "Two weeks, in fact. Now shall we start listing the names?"

"I'm not going to give you any names."

"Oh, yes, you're going to, early or late. Another few weeks with the Life Simulator, another few months at most, and you'll give us all the names and you'll give us the confession. You'll go down on your knees, you'll cry, Sellek, you'll beg me to let you tell me how many others are in your organization."

"I'll never tell you anything. I'll never sign anything." He stood, legs still unsteady. "You can use any kind

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of torture that the West States Loyalty Police can come up with."

"We'll continue with the Life Simulator, Sellek." Hernandez tapped his upper teeth with the pen. "When we first brought you in four years ago—"

"It wasn't four years, it was six months ago."

"When we first brought you in for treason against the West States Republic, Sellek, we found out several things about you," Hernandez continued. "You're stubborn, and you're imaginative. I suppose a man in the documentary vidisc business needs an imagination. Most of the physical tortures wouldn't work against you. We also learned, unfortunately for us all, that your little antigovernment group had inoculated you against the truth drugs. That left us only one certain way to break you, through your imagination."

Sellek watched the black simulator. It was nearly as tall as he was. He moved closer, kicked at one of its wheels. "You're never going to get the rest of those names out of me."

"We have them all already, we only want your confirmation."

"No, you don't. If you did you wouldn't—"

"Wouldn't we?" said Hernandez. "People like you, Sellek, who conspire against the legitimate regime of the republic deserve any—"

"There's nothing legitimate about Bonner's government. He came to power by—"

"I've no time for debating." Hernandez rose up. "Sit in your chair and give me the names of all the others. Halliburton's one, isn't he?"

"He's my partner in the vidisc business, that's all he is."

"You don't have a business, Sellek. It collapsed years ago."

"Six months!" He shouted suddenly, taking a step toward Hernandez. "I've only been here six months."

Hernandez pointed at him with the stunrod. "You've been here five years," he said. "Now sit in that chair and give me the names."

"No."

Laughing, Hernandez said, "You think it's been rough so far? You think seeing your only child die is as bad as it can get?"

Shaking his head, Sellek said, "I'm not going to tell you. Eventually Bonner is going to fall, and then I'll be out of here."

"Bonner fell three years ago and you're still here."

"I've only been," said Sellek, teeth touching, "in here six damn months."

"Things are going to get worse, Sellek. You'll live through terrible things and you'll believe they're really happening. You'll see everyone you love die, die in absolutely dreadful ways. We can program the box for much worse simulations. In every part of you, in your brain and in your bones and in your blood, you'll believe every minute of it is really happening. We'll knock you out and hook you up and you'll never know it isn't all real. You'll live through more pain, more trouble, more dread than anyone ever

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has. You'll die of cancer, come back to life and die again of a new and more horrible cancer. You'll see Halliburton smashed to bits in a skycar crash, you'll—"

"Never going to get anything, Hernandez. You'll fall when Bonner falls."

Hernandez laughed. "I'm going to get exactly what I want from you," he promised.

A new man came into the cell. He was smiling, and there was an outside feeling about him. He didn't seem to belong inside the smooth gray walls of the prison. "It's all over, Sellek," he said, holding out his hand. "You're free."

Sellek hesitated. Many of the other simulations had started in similar ways. "Who are you?"

"I'm Mack Daniels. I'm with the Interim Police Commission," he explained. "Bonner has been overthrown, we're in the process of setting up a new government. One that'll give way, very soon, to an elected one. Meanwhile the interim government has declared a general amnesty for all political prisoners. Come on, I'll see you get home."

There was no way around it, he had to go through this. Once they stuck that damn box to him, let all those wires dig into him, he had to ride the illusion out. It wouldn't stop, not until Hernandez was ready. "That's good news," he said with only moderate enthusiasm.

"You've had a very rough time," Daniels told him. "We know what they've been doing to you. To hold out for seven months, that takes a lot of guts."

"I was right. It's only been six or seven months. Hernandez tried to make me believe it's been years."

"Hernandez is dead." Daniels led him out into the corridor.

That sounded fine. Even if it were only part of this new illusion the Life Simulator was building inside his head. "My family?" he asked.

"All doing well. I'm taking you there. We've been able to get your beach house back for you."

"Back?"

"Bonner's government took it a while after you were arrested. Your wife and daughter have been living with her mother in the Glendale Sector."

"Mary Liz, my little girl, she hasn't been sick?"

"She certainly doesn't look it. You'll be seeing her in a few minutes." He reached out, opened a door and there was sunlight everywhere.

Sellek flinched, the brightness hitting him like a gust of wind. And the air, so much different than the filtered processed stuff fed into his cell. Was Hernandez trying something new? The simulator hadn't done this good a job before. "Outside world's still here," he said.

"Bonner's fall was accomplished with very little bloodshed or violence." He guided Sellek along the ten-story-high walkramp they'd emerged on. "By the way, Jake Ramoz said to say

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hello. He's working with the new police commission, too."

Sellek had been taking in the multicolored towers and ramps of Greater Los Angeles. He halted. "What?"

"Jake Ramoz. He was in your unit, wasn't he?"

How had they gotten Jake's name? Hernandez had never fed Jake into one of these illusions before. He could only put in what he knew about Sellek and his life. What had happened? "Yeah, sure, we're friends."

Daniels took him to a skycar landing yard. "Going to take you a while to get over your wariness," he said. "We know you didn't tell them anything all the time you were inside."

"No, I didn't. No." Sellek glanced back at the fifty-story-high Security Police building, gleaming silver, poking up through the clear blue afternoon. He knew, was fairly certain anyway, they couldn't get at what he thought and said when he was hooked up. Unless he blurted out something aloud. So it didn't hurt to talk about Jake Ramoz inside his head. Except he couldn't figure how—

"Get in," Daniels was repeating.

Sellek noticed the open passenger door. He climbed inside the scarlet skycar.

Less than fifteen minutes later Daniels said, "There they are."

Sellek looked down through the floorwindow. There was his wife, and his daughter. The two of them gazing skyward on the yellow sand. Kate very still, arms folded beneath her small breasts. Mary Liz, golden hair flying, jumping up and down in the way she

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always did when she was excited, fists clenched and elbows tucked in.

He hoped it wouldn't end yet.

The slim naked girl was standing by the wide oneway window and watching the night. "This should have happened before," she said.

Sellek sat on the edge of the round floating bed. Stars and a half-moon bright up above the oneway dome of Carrie's bedroom. "It's happening now," he said.

"OK, we'll settle for that."

A mailrocket went rushing across the darkness above the tower apartment. Sellek had been free nearly a month now. That was much longer than any of the other illusions had lasted. Things had been going very well, too, not what Hernandez had promised him at all.

Watching Carrie he felt very content. She was very special. He'd felt that during the first year she'd worked for his vidisc outfit, all that year before he'd been arrested and taken away. With her there was none of the tension he always felt with Kate. Kate was worse now that he was free again. He loved Mary Liz, but . . .

Maybe things would work out. Soon as he and Halliburton got their business back to where it had been, then he'd arrange an end to his marriage with Kate. He'd see to it he kept Mary Liz.

"Why are they letting me feel this way?"

"What?" Carrie returned to him.

"Nothing, I was . . . nothing at all." He put his hands on her smooth warm back.

How did they know about the others in the organization? It wasn't only Jake Ramoz. Since he'd been out Sellek had seen most of the others. Had dinner with some of them, talked about how things had been before the end of Bonner. Where did Hernandez get the names? Christ, did he have the whole list all this time? Had Sellek gone through all this simply to amuse the Security Police? To live all these fragments of life, these awful variations on what might happen, to see his daughter waste and die . . . for what?

"You can't forget," said Carrie, touching him.

"No, not yet."

The twilight beach was silent, his low white and blue house seemed to float there just beyond the sand. Selleck dropped out of his skycar, crossed the landing-lawn to the rear door. He smiled, anticipating Mary Liz. She'd come popping out and hug him, like a sloppy tackler, around the knees. Jesus, it was two months. A long time to have this damn illusion of being free.

His little daughter didn't appear. Sellek, frowning, pushed into the house. "Kate," he called. "Hey, where is my bouncing offspring?"

"At my mother's." Kate was in the doorway of the dining area. Arms folded, face pale.

"She OK? She's not sick?"

"I wanted to talk to you."

Sellek went around her, into the

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living area. Back to his wife, hands in pockets, he watched the light draining out of the sky, the gulls turning black as they skimmed low over the sea. "We talk all the time. Mary Liz isn't in the way. I'll go fetch her."

"Listen first."

"OK. Something bothering you?"

His wife said, "I don't want you dropping me in favor of Carrie."

He kept his eyes on the darkening ocean. "You found out."

"Yes, and I know what it means."

"Not hard to figure. I'm tired of this, I want it to end."

"You didn't feel that way before you were . . . taken away."

"No, Kate, it's an older feeling."

"I don't think so, Ross Halliburton doesn't either."

He faced her. "What the hell does he have to do with this?"

"Ross agrees with me, you're not the same since you came out."

"Right, I'm not. I'm happier. I'm happy with Carrie, happier than I've ever been with you." He came closer to her. "I'm going to take Mary Liz and I'm—"

"No, you won't take her. You'll never have Carrie either," Kate told him in her calm, even voice.

"Saying that doesn't make anyth—"

"You should have had help when you came out. I mean beyond what you got."

"Not loving you, Kate, isn't a symptom of illness."

"There are a lot of signs. I've gone over this with Ross and he agrees we've got a very good case. Please try to understand this, Nat. I think you should be put . . . well, into some kind of institution for a while. A place where they can help you to—"

"No! Not inside anybody's walls. Not ever again."

"The things they did to you, the methods they used. I don't think you realize how much—"

"No, Kate." He put his hands on her shoulders. "You're going to give me Mary Liz and you're going to let—

"No, damn it." His fingers moved to her throat and tightened. "No, Kate, no."

She spoke no further.

In a moment he let her go.

Kate fell a little at a time. To her knees, over onto her elbows, then to her left side and finally sprawled out.

She was dead. He didn't have to check.

Sellek moved away from her. And the time began to stretch out.

"Jesus," he said, feeling coldness go forking through him. "This is real this time. It's all been real and I thought . . . Now I'll lose Carrie and Mary Liz, too. I'll—"

Then the laughter came. Harsh and nasal cutting through the slowly fading illusion.

The Bonner regime fell a week and a half later.

They came to let Sellek out, telling him a general amnesty had been declared. They told him things were going to be fine from now on.

But he never believed them. ■

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pelotas

Despite all obstacles, science—and human cussedness—will persevere.

Edmundo Hamiltowne

Doctor Roberto Gasmo left his home in a hurry to make his usual bus. At home, he had left a disgruntled wife, forever complaining about a lack of money, and his three children, fighting and shouting to each other.

"Damn the early morning routine!" he said to himself while buttoning up his raincoat. It was raining, as it often did in Lider Esperado, capital city of the Republic of Eterna Esperanza.

DOUG BEEKMAN

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He made a 100-meter sprint along the narrow street and arrived at the Instituto de Investigacion (a former stable refitted for research purposes) at 9 AM sharp, and signed the entrance sheet, ignoring the sour look of the Chief of Personnel at seeing him on time. Both Dr. Gasmo's time of arrival and his large salary (10 billion pesos monthly, around $32), were a constant source of envy.

He then proceeded toward his lab. His half-starved companions looked up as he went by—uncombed hair, shirt and no tie, or vice versa, unmatched shoes, an unzipped fly—there was always something about him to relieve the routine.

While Dr. Gasmo was putting on his lab coat over his drenched raincoat, he noticed that everything looked foggy. After wondering for a while what had gone wrong with his sight, he suddenly realized that his thick glasses were wet, and proceeded to dry them. Dr. Gasmo then started his routine, examining the cages where very old BALB mice were philosophically awaiting their demise. Dr. Gasmo was carrying out a study of longevity on them.

Startled, he gave them a second look, and pulled out cage after cage to closely study the mice. Yesterday he had left them as senile as ever. Today they appeared to be in the flower of adulthood and, what was more, they had become tame, curious, and easy to handle. Even a ferocious male, smoldering in solitary confinement after chewing off the testicles of his less fortunate cagemates, cozily nested in his hand.

Their chow had been changed the day before. Aside from that, no other variables had been modified. Dr. Gasmo therefore concluded that this new batch of rodent chow might have some bearing on what had happened, so he decided he had to visit the supplier. But for that, he had to leave the Instituto during working hours. And for that, alas!, he needed permission.

His first step was to make an appointment with the Chief of Personnel, which was graciously granted three days later. Captain Tarugo received Dr. Gasmo, but was shocked at his request. What Dr. Gasmo asked was tantamount, for him, to sabotage. When Tarugo could fight back his patriotic nausea, he suggested filing form 3H-AA-M1 (Request for Audience with Directors of Institutes) and dismissed Gasmo curtly.

Three months later, Dr. Gasmo was summoned by the Director. Colonel Doctor Alpedo deferentially listened to him, but did not know what to answer. In his thirty-seven years of civil service he had never heard such as unusual request. With awe in his voice, he suggested that Dr. Gasmo ask for an audience with the Minister. So Dr. Gasmo filed form 3H-AA-M2 (Request for Audience with Ministers) while Colonel Dr. Alpedo filed form 3H-AA-M3 (Permission Granted by Director of Instituto so subalterns may ask Audience with Ministers). Both forms left the Insti-

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tuto by their usual channels.

Six months later Dr. Gasmo was summoned to the Presence. His Excellency the Minister received him in his sanctum sanctorum, scarcely eight hours after he was announced. In his beribboned blue-and-gold uniform, Admiral Chancho cut an impressive figure, for he was atrociously fat. He frowned deeply when Dr. Gasmo explained the reason for his errand. He didn't understand well. Everything was far too complicated for him. In Admiral Chancho, the abundance of lipoids around his midriff vied with that of the lipoids in his encephalon. He ended the audience by promising Dr. Gasmo that he would closely study the matter with his advisors.

One year later, Dr. Gasmo was notified that permission had been granted.

He immediately went to see the supplier of rodent chow, and asked about that particular batch. Señor Chorro, on edge due to this very unusual visit, didn't remember that batch at all. He gave Dr. Gasmo the names and addresses of the thirty-five suppliers of the different stuffs that made up the chow, and attempted to bribe him. Dr. Gasmo accepted the former, rejected the latter, and left Señor Charro's office in disgust.

His first thirty-four visits yielded no results. His thirty-fifth and last interview was with Señor Caballo, supplier of molasses.

"Please don't squeal on me! Think of my family!" said Señor Caballo, trembling like a leaf. After appeasing him, Dr. Gasmo learned that Señor Caballo's source of worry was a barrel of molasses that had inadvertently been left open in the sun for six hours, but had then been sent, nevertheless, to the chow supplier.

The date checked. Dr. Gasmo declined a bribe (as he had done in the previous thirty-four visits), and left happy at having something to work on.

On his way back to the lab, he walked into a grocery store and bought a bottle of molasses. He then proceeded to put half of it in the sun for six hours. Meanwhile, he got twelve very old BALB mice and divided them at random into two groups. To the first, he fed molasses straight from the bottle and, to the second group molasses baked in the sun. The next day, mice of the first group looked as old as before, while those of the second appeared young. He repeated the same experiment three times, using mice of both sexes, always meeting with success. Then he went to see Dr. Chifuleti, an outstanding, if undernourished, chemist and life-long friend. Dr. Gasmo told him what had happened, and asked him to find the active principle.

After several experiments with extracts and more extracts, Dr. Chifuleti finally isolated it: para-ethyl-lauyl-ortho-thymoic acid sucrose, *Pelotas* in short.

Dr. Gasmo then sent a manuscript, describing the action of Pelotas on BALB mice, to the leading geriatric journals in the world. The manuscript

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was rejected by all. Comments of the editors were biting.

Dr. Gasmo, deeply in debt now due to mailing expenses, felt that this was the end. He considered suicide. On second thought, that night he took a dose of Pelotas.

The next morning he awoke early, recalling an odd dream: all the forces of the Universe had condensed into a single beam, and that beam had then become fully aware of itself, and it was his Self, his life. He had known he was the King of the Universe. His first subject, he realized now, was his body, suddenly torn away from the slumber of the ages.

He noticed his wife, peacefully sleeping by his side, and that tide of joy became a flood of tenderness. He started to coo and to caress her. Her startled shock soon melted into infinite passion, and he made love to her as no man had made love before this side of Eden—he was half angel, half faun, all man.

She got up in ecstasy and made him breakfast. His children woke up happy at seeing their folks so blissful.

His demeanor also changed. He was assured and purposeful now, and he astonished everybody at the Instituto. He could also see perfectly without his glasses.

A few days later, he learned that the XIV International Congress of Geriatrics and Gerontology was going to be held in a neighboring country. He borrowed money and went. He left with a heavy heart, however. Dr. Chifuleti, his lifelong friend, had quietly died of starvation a month before, and even though all the forms had been filed, permission for burial had not yet been granted.

At the Congress, his quiet stance, soniferous voice, and frayed clothes hanging from his emaciated frame, made a deep impression on the audience. Enthusiastic workers asked him for Pelotas, so he soon gave away the 10 mg of pure drug that he had taken with him.

For the next three years, all was peace and delight in Dr. Gasmo's life. Mrs. Gasmo had also taken Pelotas, of course.

One day, at the lab, Dr. Gasmo was told that two people wanted to see him. In came Dr. Carl Fron, Chairman of Montoto Pharmaceutical Company and, at his heels, his representative in Lider Esperado, Dr. Juan Olfa, servile and solicitous as ever. They wanted to buy the formula of Pelotas. They offered $10,000. Dr. Gasmo agreed.

Extract from the conclusions of the XV International Congress of Geriatrics and Gerontology (Brussels, 1979): ". . . Pelotas has been reported to rejuvenate elderly patients . . . Metabolic studies have shown that Pelotas balances ana- and catabolism . . ."

Extract from the conclusions of the XXX International Congress of Orthopedics and Traumatology (Tokyo, 1980): ". . . Pelotas has been

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reported to produce appearance of new limbs in amputees, only if the phantom-limb syndrome is present . . . New limbs are normal in size, proportion, sensitivity, and motility . . . If the phantom-limb syndrome is absent, regrowth is defective . . . Punch biopsies of newly growing limbs appear microscopically identical to embryonic tissues, whereas in the fully developed, the appearance is that of tissues seen in normal limbs of the corresponding age group . . . Polio patients show full recovery when treated with Pelotas . . ."

Extract from the conclusions of the II International Congress of Sexology (London, 1980): ". . . Pelotas permits women to ovulate at will . . . Pelotas leads to development of sexual identity, permitting complete communication with the partner . . ."

Extract from the conclusions of the XXIV International Congress of Neurology and Psychiatry (Buenos Aires, 1981): ". . . Pelotas has been shown to selectively destroy certain points of mitochondria of a previously unknown bundle. This small bundle that connects areas of the frontal lobes with the hypothalmus, has been baptized *Bundle of Gasmo.* Effect is irreversible and is obtained with a single dose of .01 mg/K . . . No changes have been reported in other areas of the central or peripheral nervous system . . . Pelotas easily crosses the hematoencephalic barrier . . . Electroencephalic studies show a rapid-fire pattern of waves in the Bundle of Gasmo of controls, whereas in treatment with Pelotas, tracings show a sinusoid wave . . . Psychotic disorders disappear after treatment with Pelotas . . . in retarded children, IQ has been reported to increase dramatically after treatment with Pelotas . . . Neurotic disorders have been reported to vanish after treatment with Pelotas, due to the disappearance of fear . . ."

Extract from the conclusions of the XIII International Congress of Cancer (New York, 1982): ". . . Pelotas has been reported to produce a remission to normal of all malignant tissues. This effect has been seen in solid tumors, lymphomas and leukemias, both experimental and human . . . Mode of action has not been ascertained . . ."

Report issued by INTERPOLE to all Police Forces (Paris, 1983): "Sexual derelictions, prostitution, and narcotics trade has decreased dramatically over the past two years. This phenomenon could be tentatively ascribed to the widespread use of Pelotas."

From the Juan Perez Show, highest rated in the TV networks of Eterna Esperanza:

Juan Perez: Thank you ever so much, Dr. Gasmo, for coming to our show. Everybody here in the audience is dying to learn how you discovered Pelotas.

Dr. Gasmo: Well, it was quite by

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chance. One day I found that some very old mice were looking young, and found that it was due to the consumption of molasses . . .

J. P.: Molasses?

Dr. G.: Yes, molasses. By mistake, a barrel had been left open in broad daylight. We then found that ultraviolet light acts as a catalyst with environmental microorganisms that produce Pelotas from molasses.

J. P.: You mean to say that by taking sun-baked molasses you can actually take Pelotas?

Dr. G.: Why, sure! With a couple of tablespoons of the stuff, baked in the sun for one hour, you can take a full dose of Pelotas.

Dr. Gasmo left the studio driving his brand new car. He was feeling a bit under the weather. Being the darling of the scientific world had exposed him to the seamy side of life, and he had seen so much mediocrity, lust for power, petty intrigues, vested interests! He shivered, and for a moment he wished he could have been spared such a frightful experience.

Six months later, Dr. Juan Olfa, representative in Lider Esperado of Montoto Pharmaceutical Company, received a letter from the Chairman:

Dear Juan:

Sales of Pelotas are dwindling. Economic advisors tell me that this could be due to comments Dr. Gasmo made on a TV show. Could you kindly check, since you are on the spot?

Sincerely, CARL FRON

Dear Dr. Fron:

You are dead right in regard to the cause of the dwindling sales of Pelotas! How intelligent and subtle you are!

I was so furious about it that I went to see the President here and hinted that he may have problems when refinancing the national debt unless swift merciless justice is done. He immediately phoned the President of the Supreme Court of Justice.

So don't worry, we'll have every penny back and we'll ruin Dr. Gasmo for life.

But nevertheless, what a shameful disgrace!

I hope you are happy and proud of what I did. As always, at your feet,

Your obedient slave,
JUAN OLFA

Dr. Gasmo accepted equanimously this ebb of fortune. His joy was within. He and his family moved into the storeroom of the Instituto, where they had to live amid unused rodent cages and bags of rodent chow. Their diet was rat meat and grass from a neighboring lawn. They were penniless, had to sell everything and, what's more, Dr. Gasmo's salary had been confiscated for the next twenty years.

The tide of opinion was against him, for he was an underdog now. Feelings ran high among physicians,

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who had lost their patients; lawyers, pimps, prostitutes and drug peddlers, who had lost their clients; and armed forces, who saw fear, the keystone of their structure, melting in front of their eyes.

Several well-known physicians used to meet one evening a week to eat, talk shop, and exchange gossip. At one such meeting they were all quite angry. When the meeting broke up, Dr. Espéculo, the leading gynecologist, was furious; perhaps because he realized that quite soon he would have to move to more modest dwellings. He also recalled, with surly delight, that the next day Mrs. Cubo, the President's wife, had a routine appointment with him. He knew his patient well: a harebrained, timid, self-effacing, girlish, flabby thing of fifty-four, frigid to boot due to her strict Victorian upbringing. He also knew that he had an enormous influence over her.

He received her with a well-rehearsed frown.

"Is something the matter with me?" she asked in her girlish voice.

"No, nothing at all," he replied with a tired voice.

"What is the frown for, then?" she asked, her curiosity aroused.

"Well, it's Dr. Gasmo," he answered. "Morals are loosening, and I fear the day when women will not be safe in the streets or in their own homes. We both have daughters, after all," he concluded brutally.

Her initial shock at Dr. Epéculo's words slowly gave way to increasing agitation. By the time she entered the Government House and interrupted her husband, she was at the end of her wits.

General Cubo, who was presiding over a full cabinet meeting, was stopped in mid-sentence by the apparition of his hysterical wife.

"Women are being raped all over Eterna Esperanza!" she moaned hoarsely. "Something must be done with Dr. Gasmo!"

Whereupon she was seized by a fit. When, still writhing and foaming, she was carried away to a waiting ambulance, there was a protracted silence in the chamber.

"Well, gentlemen?" said General Cubo, when he found his voice.

"We can't arrest him. He is too well known abroad," said General Cuadrado, Minister of Internal Affairs. He had learned to be careful after the scandal that followed the expulsion of the bishops.

"I know," snapped General Cubo.

"Perhaps mob justice? Perhaps a lynching?" suggested General Cuadrado.

General Cubo thought it over, tugging furiously at his mustache, his pride and joy.

"That's it!" he suddenly said. "Round up all of Dr. Gasmo's enemies, let them loose tomorrow morning, and give the police the day off!"

General Cuadrado bolted out of the room and gave the necessary orders.

At that moment, the Gasmos had just finished their meal of rat meat and grass. They were sitting on the

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floor, leaning against bags of rodent chow. They were all content.

"Life has given me everything," said Dr. Gasmo. "The joy of discovery, fame, money, disgrace, poverty . . . everything . . . that is, except . . . remember that valley poor Dr. Chifuleti used to tell us about, lost in the mountains?"

"You mean the one with goats and sheep, a clear waterfall and an abandoned hut?" answered his wife.

"Right! I was wondering about leaving all this and going there."

All were enthusiastic.

"What if I go to uncle's to borrow his car, so we can go there now?" asked his son, stars in his eyes.

"Well, go if you wish," Dr. Gasmo told him dubiously, "but I wasn't thinking of leaving so soon."

The next morning, after breakfast, Dr. Olström, Swedish Ambassador in Eterna Esperanza, received a telegram:

SWEDISH ACADEMY OF SCIENCE WILL AWARD NOBEL PRIZE IN MEDICINE THIS YEAR TO DR. ROBERTO GASMO STOP KINDLY TELL HIM STOP THE PRESIDENT OF SWEDISH ACADEMY OF SCIENCE.

Dr. Olström, respectful of protocol, asked Air Frorce Brigadier Obtuso, Minister of Foreign Affairs, for an urgent audience. He was received fifteen minutes later and told Obtuso the news. When Dr. Olström suddenly found himself alone, he goodnaturedly thought that if Brigadier Obtuso had blanched, then turned purple and finally run out of the room it was only a normal emotional reaction to such a momentous occurrence.

Brigadier Obtuso was frantically dialing General Cubo's private telephone number.

"Hello!" he whispered urgently. "For God's sake, stop the mob! Dr. Gasmo has been awarded the Nobel Prize! What? . . . The Swedish Ambassador just told me!"

General Cubo felt his scalp prickle as his hair started to stand on end. He pressed a button on the intercom.

"Stop the mob! Dr. Gasmo has been awarded the Nobel Prize!"

"I have no police!" came back the voice of General Cuadrado.

"Then send the tanks!"

Thirty minutes later, all the Tank Army Corps in rolling condition (fifteen out of one hundred surplus World War II tanks) were heading toward the Instituto at 20 mph, top speed that could be wrung from their asthmatic engines, under the command of General Planta. Bystanders, half-choked by the exhaust fumes, didn't know whether to cheer or to hide from this unexpected parade. As the caravan proceeded, they noticed that the guns of very few tanks were proudly pointing forward. Most had their cannons aiming this way and that, upward or downward. Onlookers gasped in surprise as the last tank passed by, for this amphoteric machine had its gun aiming directly backward and a little downward. This was not due to sloppiness, far from it: the problem lay in the fact that the Army had run out, long ago, of spare parts. So if the tanks couldn't roll,

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they just wouldn't roll; and if their guns and/or turrets got stuck, they just had to remain that way. Finally, the tanks made contact with the mob in the narrow street that ran by the Instituto.

"Stop engines!" barked General Planta. The tortured engines went off with grateful hiccoughs.

"Aim and open fire!"

Tanks able to do both complied. Crews of those with torticollis perforce ignored the first order but obeyed the second. As a result, although several shells hit the mob, most were fired in every conceivable direction.

Some shells got mercifully lost in space, two landed in the Government House, where everybody believed that the 847th revolution against General Cubo's regime had begun. One blasted a market place ten blocks away, killing several chickens, vendors, women, and children; and one hit the Instituto's deposit of inflammable materials, which went up in flames together with the whole Instituto. The crew of the last tank was firing like mad their backward and downward aimed cannon, with such bad luck that all shells landed—and exploded—in the ground floor of a huge twenty-five-story apartment building that stood immediately behind the mob and in front of the Instituto. Then, a stray shell hit and blew up General Planta's tank. General Cagueta, second in command, got frightened at this turn of events (it didn't take much to scare him, anyway), so he ordered a stop fire and a speedy return to barracks. A few seconds afterward, the twenty-five-story building groaned and fell over onto the mob and the Instituto, turning all dead, wounded, and alive into a bloody mess.

By the time the firemen arrived, ten blocks were ablaze and the fire, aided by the wind, was completely out of control.

That evening, an unexpected downpour put out the fire, but not before one-third of the city had burned to the ground and one-fourth of its population had roasted to death.

At 9 PM the Government News Agency issued the following report:

"The Military Junta that governs Eterna Esperanza regrets to announce that Dr. Gasmo, our foremost scientist and Nobel Prize winner, perished in the accidental fire that destroyed part of the city of Lider Esperado."

The next morning, assorted bits of charred remains, heaped in five coffins, received an impressive and stately funeral.

Dr. Gasmo and his family were, at that moment, happily rebuilding the hut, in the midst of indescribable joy and beauty, for Dr. Gasmo had finally yielded to his family's enthusiasm and they had all left for the valley as soon as Dr. Gasmo's son had brought the car.

And, all over the world, in bottles, pots, and pans of every size and description, molasses was being baked in the sun. ■

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the reference library LESTER DEL REY

SUICIDE DEMI-URGE:
I'll never understand why so many writers of science fiction seem to have an urge to go picking around in all the garbage heaps of writing, looking for discarded and useless things with which they can clutter up their technique. Even when they are warned by every worthwhile book of writing instruction that some of those things are pure poison and sure to kill a story, they still feel the fatal attraction.

They still seem to feel that there is something ennobling about a frame in which to encase a story, even though the frame story has been dead and diseased by overuse in general literature for a couple of generations. (A frame story is one in which the writer doesn't sit down and simply write. First he tells how some idiot or other sitting somewhere does the telling, probably as a boast or a lie. That, of course, lends verisimilitude to the story.) About the only virtue of the discarded frame is that it fills more word space; but since both editor and reader are wise to the trick, it usually results in a story not being read.

Another discarded piece of junk is the trick of writing a story as a series of letters, telegrams, news clippings, etc. That was worn out long before Alexander Botts sold Earthworm tractors in the pages of the old *Saturday Evening Post*. It has at best a certain measure of cuteness when used by a writer of sure skill. Usually, it simply puts a screen between the reader and the characters and manages to reduce whatever intensity a story may have. Of course, some of the more modern writers have learned to mix it in with passages of straight narrative—thus destroying whatever use it may properly have, as well as jerking the reader from one mood to another.

In any well-furnished writer's garbage heap there must be at least one deus ex machina. It's a dangerous beast, capable of disguising itself in the most subtle ways. But it is sure to be gathered up by some writer who is seeking an ending to a story, which it guarantees to supply.

How about a shot of first person? That gurgles nicely in the old bottles lying around, and it's a lovely color. And besides, there are stories here and there that permit such a style to be used effectively. (Anyhow, look at the suspense the mystery writers get with it.) Of course it makes it harder to give rounded characters and it limits one to a single point of view—besides being something that most readers don't quite like (except perhaps—but not surely—in the mystery field). Or maybe a little of it mixed in with third-person—? It's almost surely fatal, but very attractive, apparently.

Or how about some present tense to jazz things up? That comes in most attractive and artistic hand-letterd boxes. It gives your story that certain difference! Of course, it will fool you

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by making you think that using it makes your writing flow—just as an outline for a story does in present tense. You won't notice that it's also subtly distorting that style—though the reader may. But if anyone objects, you can find a used retort in the garbage to fling at him: "That's my style!" Or perhaps, "You just don't understand art!"

And if worst comes to worst and you can't tell a story directly for some reason, you can find lots of heavy-handed satire to cover it over with.

I keep being amazed at the number and variety of things that can be salvaged from the discard by any writer willing to dig a bit.

A case in point:

John Varley is one of the most promising young writers making a reputation for himself today. He has done a number of very good novelettes, and his work has seemed to get better and better. When I heard he had written a novel, I was genuinely looking forward to a chance to read it.

Well, I've read it. It's **The Ophiuchi Hotline** (Dial Press, 210 pp., $6.95). It's also supposed to be the first novel to be published under the Quantum Science Fiction Program, explained to me as a plan to secure only very high quality science fiction and then give it maximum exploitation. The editor and his advisors are men I respect, incidentally.

Now obviously, after the buildup above, I'm not going to praise the book. But I wish I could damn it lightly. Instead, I found it to be one of the most disappointing books by a good writer that I've read for a long time. It's as if everything Varley knew about writing in his shorter fiction had deserted him completely when he sat down to write a novel.

To begin with, it's a kitchen sink sort of story—you know, one where everything on the cooking surfaces are scraped into the pot together to make the soup. There are invading aliens—not one type, but two. There is mankind thrust off Earth and forced to live on the Moon. There is corrupt politics and decadence. We have clones—my god, do we have clones. These are related to a means of immortality. There's an adaptation to living in raw space. And of course there are black holes.

In good writing, even science fiction, there's a desirable principle of construction called parsimony. Roughly, that means an economy of means to achieve an effect. A writer should make the most of the basic elements that he uses—and this is particularly true in science fiction; but he shouldn't clutter up his story with things that serve no real purpose in the story. Lots of decorations are fine for such schmalzy things as wedding cakes, but they don't belong on solid food—as any visit to thousands of suburban clubwomen's meetings should prove. A good story needs developing, not decorating.

There isn't the least trace of parsimony in Varley's story. (And that's strange, because he has observed the principle quite well in most of his shorter work.)

As an example, he has Lilo (the "heroine" of the story) killed, and her clone substituted for her—said clone being aware of everything right up to the moment of killing. Okay, this has a certain good dramatic quality, and

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maybe the second time also works. But repeating the idea over and over certainly doesn't add to it. And there are at least several of his characters that really serve no necessary purpose, except to decorate. The Mayor of the Moon might be a good character in some story, but after all the buildup here on his ambition, greed or what-not, he simply walks off and disappears. Or the girl with the symbiote who can exist in a dual sort of way off the sunlight in space might make a story of her own; but if she were removed from this one, no harm would be done.

The novel is also cluttered up with all kinds of stylistic garbage, too. There are bulletins—sometimes the same bulletin in three styles of writing, apparently meant as a clever display of how stupid certain classes are. And there are sections which lapse out of third-person into first-person. At first, I thought this might be a trick to show that a different clone was taking over; but it turns out that it's often the same Lilo being seen in first person as previously in third. There is no possible excuse for such cheap (meaning easy and purposeless) trickery.

Then there are the aliens from Ophiuchi, apparently. What seems to be the central plot comes from the fact that they have gotten in touch with humanity and have passed along a number of highly advanced scientific ideas—with the immortality trick coming from such messages. Now suddenly, they are demanding that mankind pay up the debt for such service—or else! And nobody has the least idea of what kind of pay they want. Okay, that's not a bad plot problem. (The solution to it all turns out to be cream-puff stuff, however.) But we are told that the messages from them are almost impossible to translate adequately, even by computer analysis. Then when we meet them we discover that they all speak perfect English—or whatever language is used by men. There's no logic to the deception, because they could have gotten what they wanted far more easily by speaking clearly from the first.

There's a lot more stuff mixed up in the novel, including another alien race totally unrelated to the Ophiuchians and now in possession of the Earth; also a couple of miraculous passages to and from Earth by one of the assorted Lilo-clones. But why go on? You'd have to read the book to find out what any kind of criticism meant—there's no way else to make anything plain.

And the book simply isn't worth reading.

After far too many years, Algis Budrys has a new book, **Michaelmas** (G. P. Putnam's, 243 pp., $7.95). At his best, I consider Budrys one of the best writers in the field, and I've been sure of that ever since I was lucky enough to purchase the first story he had published, way back a quarter century ago.

Again, I looked forward to reading the novel, having deliberately avoided the magazine version to enjoy it at a sitting. And for more than two hundred pages, I was thoroughly delighted. He was even better than he'd been in the past. The writing was clean, sharp, and very effective. He drew his characters quickly and firm-

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ly, not by telling about them, but by showing them. (This is the sort of book that tempts a writer to tell it in first person—but Budrys wisely avoided the trap.)

There's an absolutely wonderful computer in the story, one that is sentient and can do almost anything and be almost anywhere, all for very good reasons. This could have wasted long pages of history and description, but you won't find them here. There is an explanation of the development of this computer—but it's slipped in casually, after the reader has become fully accustomed to him. (The computer seems to be "him", since that fits the personality better than "her" or "it".) Just a couple of sentences telling what his original purpose was, showing from what he evolved. And as Budrys constructs his story, that's enough; the reader familiar with science fiction will be able to grasp the whole idea on his own.

And it all explains Michaelmas, the hero of the book. He's shown as the most powerful man in the world, the bastion between humanity and destruction, in effect a superman. He's also shown as a normal, decent newspaperman, good at his profession, but with no miraculous abilities. The two views of him don't conflict, and there's nothing contrived or hokey about it. There are a number of other good characters, including a girl who may or may not be all that she seems. (I found that I couldn't agree with Michaelmas's final reaction to her, but it was a reaction I could understand easily and believe.)

There's also a mystery. An astronaut has crashed on landing back on Earth and his craft has gone to smithereens. He's about as completely killed as any human being could be. And now, early in the story, it's announced that a remote sanitorium has taken in his injured body and healed it—without any remaining injury to show for the accident. It's clearly impossible—but the man is for real. And since there seem to be some kind of sinister forces at work behind the scenes but somehow connected with that reappearance of the living man, Michaelmas is forced to investigate. Good feeling of suspense, without any forced development.

Then I get toward the end of the book and find a deus ex machina behind it all—or in this case, maybe I should call it a deus in machina.

It's something that couldn't be assumed, couldn't be a logical outgrowth of the givens of the story. Sure, there had to be something darned strange to account for what was going on; but this is somewhat like reading a locked-room mystery that seems normal, only to find out a little pink fairy simply whisked the murderer off into the fourth dimension!

So I can't give the novel the recommendation I was hoping to give. And yet, so much of it is so good that I can't really advise against it. (Maybe some readers won't mind the ending, anyhow.) Those first two hundred pages are so damned good! All I can suggest is that the book is worth reading for the good parts, but be prepared not to like much of the ending. Normally, I consider a bad ending fatal to a story. In this case, I'm not sure.

Now to cover a couple of things

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briefly, since both the above books aroused such strong reactions that I've run on:

Macmillan has embarked on a program of bringing out the leading Soviet science fiction, and they've undertaken to provide good translations direct from the original Russian, rather than the bad double translation that has afflicted some of Lem's work here. (They've succeeded well in this.) Among their first books is a volume containing two stories by Arkady and Boris Strugatsky, **Roadside Picnic** and **Tale of the Troika** (245 pp., $8.95). From the little Russian science fiction I have seen, the Strugatsky brothers are perhaps the finest writers of the form there, so this should be a fair sampling.

Roadside Picnic has a good idea for a novel, too. Earth has apparently been visited by several alien ships. Those stayed for a short time and then took off, leaving behind them a collection of strange objects. It's like a picnic party in the country, leaving behind all its garbage. But in this case, even the garbage is far in advance of human technology.

This is the story of some of those who are now trying to study or to loot the garbage for its treasures. There are very real treasures to be found, too—but many of the things left are incredibly dangerous. Most of the story details the life of one of the looters over a period of several years. It's a downbeat story, grim and realistic, but generally extremely well done and believable.

Tale of the Troika is another matter. This is apparently a satire on bureaucracy and the power drive. But it is carried to such a level of distortion that it becomes totally ridiculous. Maybe it had to be made hopelessly unreal to get by—but if so, it was then hardly worth doing at all.

Damon Knight has written an account of **The Futurians** (John Day, 256 pp., $9.95) a subject about which he has considerable knowledge, having been part of that fascinating group of early New York fans. For several years, they were at the center of almost everything happening in fandom in the area—and they have been the subject of countless apocryphal stories.

It was always a fairly small group of fans, as given to feuding among themselves as to stirring up feuds with other fans. And as the book explains, it was a group that was to have a later effect on the world of science fiction far beyond their number. From it came "eight novelists, a publisher, two literary agents, four anthologists, and five editors."

Until now, we've had mostly disconnected anecdotes from one or more members, plus assorted comments at the time from their enemies of the moment. Now Knight has filled all this in, partly from his own knowledge and partly from a series of interviews he taped with all of the members he could still reach.

The book enriches the knowledge that has so far been assembled and corrects a lot of errors. It also traces the lives of the members through the years up to the present.

A very good job—one that will be valuable to all students of what went on in the early world of science fiction, and a very pleasant read. I enjoyed it and recommend it highly.

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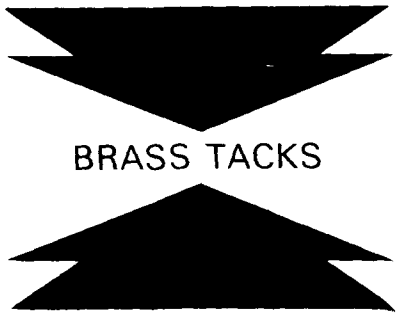

Dear Ben,

In a constructive spirit, I wish to decry the scientific bloopers that have occasionally surfaced in the stories you have edited. I applaud your efforts to broaden the characterizations, societal backgrounds, and roles depicted, but I dislike the loss of scientific rigor that I have seen in recent years.

This letter is prompted by the total impossibility of sailing a free air balloon, as described (and illustrated) in "Chimera" (Dec. 76). As early balloonists quickly learned, a free flying balloon without a motor must drift with its local air mass. Changing speed, and especially tacking, is impossible without a second surface such as water or smooth ground to provide a means of directing the craft at an angle to the air flow. It violates my feeling for the spirit of *science* fiction to see obvious errors in the basic laws of science flouted, particularly in a cover story . . . I don't feel that demonstrable errors in science should be accepted in a magazine devoted to science fact and fiction. One hopes the authors will set up the most interesting conditions, discoveries, and "laws" possible, but will follow the results with logical and emotional fidelity. I read science fiction because I prefer stories that do have explanations, and are consistent with their own concepts as well as those of the real world that we all experience.

So sharpen your editorial pencil, Ben. Maintain your drive for originality, but remember that your readership may demand the same degree of validity that they strive for in their professional or academic careers!

PATRICK H. QUILTER
1936 Placentia Ave
Costa Mesa CA 92627

The Editor, who is obviously not a balloonist, stands properly abashed. Next time we'll hang a motor off the end of our lighter-than-air craft.

Gentle sir:

Mr. Potts's guest editorial was a welcome bit of fresh air. As an honors graduate in economics and an sf reader, I have often wondered at sf's tendency to be very sophisticated and up on the latest physics (black holes and magnetic monopoles?) while being incredibly naive in terms of the social, political, and economic systems it postulates—especially the economics. It is unfortunate that persons who otherwise pride themselves on being well-informed tend toward aggressive ignorance when it comes to economics; it is downright tragic when such persons turn out to be sf people, who are so much on the forefront of creative thought about the future of mankind, at least as it is done by the intelligent layman.

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It struck me as more than simply accurate to say that "we will break the light barrier before we learn to violate the laws of economics"; it is fundamental enough to be taken as some sort of basic tenant of well-constructed sf. To convince yourself that this is so, recall the critics' tenet that in good sf, while the culture and technology may take any form, basic human nature must remain the same so the reader has something to relate to. And then realize that much of the vaunted laws of economics are merely systematic delineations of the effects of some basic facts of human nature. It is well to remember that economics is a *social* science, a study of human behavior in some of its aspects. . . .

Heinlein is a writer with real background in economics of the classical kind taught in the 1920s. I wonder how much of the wonderful flavor of down-to-earth reality his characters possess is due purely to his recognition of how basic economic behavior is to human nature. His characters make deals, take risks, have jobs, invest money and maximize their own utility with an absolute libertarian vengeance. Furthermore some of his most fully realized works of art are explications of our own (*The Man Who Sold the Moon*) and alternative (*The Moon is a Harsh Mistress*) economic systems. How much of Heinlein's enduring quality is due to the sound realism of his political and economic postulations? I suspect much more than has generally been recognized by critics. In the end the gadgets never count for much, and Heinlein's people and places *make sense*. A good part of the sense they make is economic sense.

Certainly he is the only one in the sf world to make a direct contribution to the field of economics, inventing a term now often used in college classrooms, quite probably to the benefit of those naive liberal youngsters hearing it for the first time: TANSTAAFL.

D. CAREW

Box 25
Webster SD 57274

For those who have not done their Heinlein homework, TANSTAAFL means There Ain't No Such Thing As A Free Lunch. In other words, the Second Law of Thermodynamics applies to economics, too.

Dear Mr. Bova:

If we go into solar power generation in a large way, such as the proposals to utilize large areas of the deserts for this purpose, it is bound to have extreme ecological consequences. Such as destruction of the desert ecology and massive potential changes in weather and other environmental patterns for the whole country and perhaps the whole world.

However, limited solar power electric generation could be developed utilizing existing structures with minimal impact and in fact reversing some already ill effects caused by these structures. I refer to the streets, highways and parking lots already in existence or planned. We would not only get the solar power from these blacktop areas but a marginally smaller amount of heat from friction from their use.

Technology would of course be a problem as it already is with all solar technology. There would be significant vibration problems and problems transmitting small amounts of elec-

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tricity over long distances with minimal leakage.

I think initially a solar cell battery operation could be set up to power individual street and parking lot lights, not only in downtown areas and on freeways but also for roadside parks and lighted roadsigns and highway markers.

Of course parking lots would be the easiest due to low vehicle speeds and correspondingly lower vibration problems. I don't think that expansion and contraction problems would be any worse than for any other solar power system, although they would not get the maximum efficiency related to sun following systems, they would be using existing facilities and pose much less environmental hazards than so called solar farms. I expect the big problem would be cost effectiveness and repair problems due to chug holes etc.

RICHARD G. POSTON
1917 W. McKinney
Houston TX 77019

But parking lots are filled with cars most of the time, when the electricity they might generate is needed most. And there's a strong correlation between peak demands for electrical power and peak traffic hours. Better to use rooftops, as a few buildings in New York City are already doing.

Dear Ben,

I don't know whether to laugh and bless you—or cry. One ought to be grateful for having one's illusions finally put to rest, but it's painful . . .

Many years ago, during Mr. Campbell's campaign to draw attention to the Hieronymus machine, I was in charge of a large laboratory at Boeing in Seattle. I sent for the patent and we constructed both types of machine: the one using electronic parts, the other using an inked circuit diagram. I read the explanatory material about eloptic radiation in the patent, and devised a simple experiment to see if it worked. After all, one of our tasks was defense of the B-52; a new detector system would have been valuable, and neither the Air Force pilots nor the company would much have cared that it was impossible—provided, of course, that it worked.

I set up the apparatus and got secretaries as volunteers. Now understand: they expected it to work. We were testing a new kind of system to see if it could be operated by untrained personnel; so went the story, and here they were, in a lab full of complex equipment, so why the devil shouldn't it work? Our subjects had no "bad vibes".

We put various metals in the apparatus and had the girls tune it while stroking the plate. They were to report any change in sensation. A camera automatically photographed the dial settings and a card identifying the conditions (what, if anything, was in there to be detected; subject's code number; etc.). The film was developed and handed to the analysis people.

The results were nil. Zilch. No correlation whatever between dial settings and whether there was anything in front of the prism or not, what was there, anything at all. Sigh.

So we dropped the Hieronymus machine and went back to whatever else we were doing, and I more or less figured that there couldn't be much to this particular brand of psionics. Still, I could hope, couldn't I?

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Then a few months ago you had a piece about Hieronymus again, and we were told of other startling things he's done. *Too* startling, in my judgment; results that unambiguous would, I'd think, get a great deal of attention. But perhaps not. I could still hope.

Well, hope no more. The interview (in the January 1977 issue) settles it. Now I make no doubt that Mr. Hieronymus is a kindly old gentleman well regarded by his family and I suppose by children and small dogs; but the only question left in my mind is whether *he* believes all this, or knows that it's nonsense. . . .

Scientists are hide-bound fools who refuse to look at results contrary to their theories. All of them. Sure, there are some of that ilk: but if Hieronymus has a real result, something demonstrable, not something that "worked last week, gee, I just can't understand it, maybe it's the atmosphere", I can guarantee him there are a dozen people at JPL and Cal Tech who would LOVE to see it. Sure: he might first have to put on a demonstration for someone they trust; they haven't time for every guy with a new theory. But a new *result?* I can get attention for a *result* any time. Can you imagine what Bob Forward, Carl Sagan, Bruce Murray, or Richard Feynman would give to be certain that an entirely new and unsuspected spectrum of energy really existed and could be detected? . . .

You and I know that there are plenty of people willing to go to Hieronymus and witness his results. There are fifty freelance members of National Association of Science Writers who'd give semivital portions of their anatomy to be able to prove, have real proof, that his stuff works. There are plenty of science fiction writers who would love to see it work, and who have enough credit with the science establishment to get him a hearing. You could. I could. But after reading that interview I fear I would not be willing to travel any great distance for the chance.

SO. John Campbell wanted to arouse interest and get people testing the unorthodox. He managed that. Pity that nothing came of it, but I for one certainly don't begrudge the time and effort I put into testing the Hieronymus machine. Furthermore, I'd love to hear that I was wrong after all, and that someone, somewhere, could get consistent observable results with it; but I think that won't happen. After reading that interview I'm rather certain that it's time we gave up this particular set of unorthodoxies and looked elsewhere. . . .

Science fiction people rightly know that neither we, nor science, nor the human race collectively understand very much of this universe, and that much of what we know for sure just ain't so; but I doubt that we'll restructure our knowledge as a result of the Hieronymus machine. After nearly twenty years somebody would have gotten repeatable results if they were there to be found.

P.S. Incidentally, I LOVE those Chap Foey Rider stories.

JERRY POURNELLE

Many people have reported startling results with Hieronymus machines and other psionic devices. But reproducible results seem virtually nonexistent. And predictable *results even more so. The essence of knowledge is*

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prediction. If a psionic device cannot work predictably, it is subject to skepticism—deservedly.

Dear Mr. Bova:

Having just read the January '77 issue of Analog from cover to cover, I must say that it has proved to be the most fascinating Analog I've had the opportunity to read!

Your editorial, "Christmas plus 20," is the most optimistic and hopeful I've read yet. After reading it I thought about today's technology, economics, and the political situation in this country *versus* the possibilities of NEO, L5, Moon, or Mars habitations in the next twenty years. To *me* the hopeful scenario you gave to the readers does not seem possible without important changes in our econo/politico priorities. . . .

Although I'm just as hopeful as you, Mr. Bova, I must play reality or devil's advocate with myself. I've been a reader of science and science fiction from about the age of seven, and have always been hopeful and optimistic about the fantastic possibilities thrown to me. I believe in SF and the science it reflects or predicts. But I'm also realistic.

Onward.

I was *entranced* by Bud Sparhawk's "Alba Krystal," a most delightful rendition of Snow White. It was everything and anything I could have asked for in an SF "fairy tale". Thank you, Mr. Sparhawk!

Unfortunately, Peirce's "The Missionaries' Position" did no justice to his previous stories concerning Chap Foey Rider and the Galactic Postal Union. I am disappointed. The idea was great, but the writing's gone a touch downhill. It has to do with the humor content. Too bad.

"Yes, Virginia" was fabulous. Let's see Alison Tellure do some more good writing in Analog!

"The Mildews of Mars" was well written, but was another disappointment. Endings like this are a bit hokey for me . . . reminds me of the type that ends with ". . . and then I woke up." What can I say?

As for "Stepson to Creation," *WOW!!!* I'd like to see Jack Williamson further develop this story into a full-length novel, with greater detail in the scientific background and the three cultures—the premen, the trumen, and the gods, not to mention the Fourth Creation.

Despite the occasional disappointment, this issue of Analog I rate *par excellence.* I found the Hieronymus interview and del Rey's Reference Library more than just interesting.

Thank you for such a wonderful special January Christmas issue.

COSTA RODIS
17622 Indianola Dr.
Lakewood, OH 44107

There will be more Alison Tellure stories coming up soon in Analog. And Williamson's novelette is the first part of a projected novel, so you will get to see much more of the premen, trumen, and gods.

Dear Ben:

I don't mind the larcenous Sparhawk heisting a story out of my childhood and dressing it up in SF togs. Fun's fun, even when it's Grimm. But when he has Alba Krystal climbing into the sack with her seven undersized amphibians, he goes too far.

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Dammit, that was originally a fairy story.

C. H. SCHAFER
7014 Murray Lane
Annandale, VA 22003

Have you read Bruno Bettelheim's book, "The Uses of Enchantment"? And how do you define "fairy," by the way?

Dear Mr. Bova:

I notice in the interview with Mr. Hieronymus that he attributes the killing of caterpillars to psionic forces.

I don't deny this possibility, but I can offer another simple explanation. The caterpillars were mature and ready to pupate, and instinct told them to hurry and get off the tree and find a suitable place for the change, which with many species is in the ground. That's why they were swarming off the tree. It's not unusual for a great number to leave a tree at the same time. I have known of this happening many times.

The reason there was a carpet of dead ones under the tree was simply because the kids were stamping on them, as he stated in the preceding sentence.

As to the caterpillars falling off the tree, he doesn't actually say they were dead when they fell, so I would assume they were alive until tramped on. I can suggest two reasons that live caterpillars might fall off a tree; first, there were so many they crawled over each other, dislodging some, or, second, that they deliberately let go and dropped. There's no reason to believe that caterpillars would have the instinctive fear of falling that human beings and other mammals have, since most of them are so light that their terminal velocity would be quite low, and they would be uninjured by a fall.

ROBERT D. SMITH
Route 1
Swisher, IA 52338

As with so much of the observed phenomena in the field of psionics, the data are open to varying interpretations. One key facet of scientific research is to design experiments in which the variables are controlled to the point where the experiment can be interpreted only one way. Can anyone design a "tight" psionics experiment?

Dear Ben,

I was greatly amused by Rinehart S. Potts's guest editorial in the November Analog concerning economic scofflaws, of which he obviously considers me to be a particularly dangerous variety. He likens the laws of economics to such fundamental principles of physics as the finite velocity of light.

Now even the most dogmatic economists readily admit their field is not an exact science. Certainly there are no economic laws remotely comparable even to Newtonian physics, much less to relativistic quantum mechanics. In fact the so-called laws of economics are much more like religious doctrines which become accepted over a period of time through solemn repetition by important personages.

I suspect that Mr. Potts's heated critique of my proposal for a National Mutual Fund which would generate investment in robot industries and distribute profits to the general public is

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based more on his gut reaction to heresy than to a rational analysis of the economic arguments.

More serious, however, than his appeal to nonexistent economic laws is Mr. Potts's total lack of understanding of the nature, the purpose, or the effect of capital investment (a blindspot he shares, incidentally, with a good many establishment economists, who of all people, should know better). Investment is the spending of money to make money, i.e., the using of resources to generate more resources. The net result of making a good investment is that you end up with more than you had in the beginning. Otherwise, there would be no point in investing.

Investment at the national level is a principle source of productivity increases and hence an important prerequisite to economic growth. The National Mutual Fund which I have proposed is a means of increasing the investment rate and of channeling the increase into a modernization of our nation's basic manufacturing technology. This is where long-range productivity growth comes from, and high productivity is the foundation of our postindustrial life-styles.

Mr. Potts doubts that we could find enough money to make such investments. This was precisely the problem in 18th century England shortly after the discovery of iron smelting. The banking establishment could not, or would not, make money available for industrial development. So the British factory owners simply coined their own currency which they used to pay workers for building and operating the iron works.

The result was not economic chaos as Mr. Potts's editorial would predict, but an enormous increase in living standards without inflation. Finished iron products increased the supply of real wealth far in excess of increases in the supply of money. The result was that England catapulted out of feudalism into the forefront of the industrial revolution.

I contend in my book PEOPLES' CAPITALISM: THE ECONOMICS OF THE ROBOT REVOLUTION (New World Books, College Park, Md.) that modern-day advances in computer technology are more significant than any of the inventions of the 18th century, including the steam engine. To say that we cannot afford to invest in this new technology to modernize our industrial base is absurd. We cannot afford not to.

Robot factories will increase the production of goods and services far beyond whatever amount of money is required to build and operate them. The long-term result will be strongly *de*flationary. The only inflationary problem is short term (two to five years) which can be dealt with by my proposals for increasing short term savings equal to the amount of money created for investment.

Robot factories, of course, cannot be expected to distribute purchasing power through wages and salaries since they will employ practically no workers. This is why I have proposed that the National Mutual Fund issue public dividends to give everyone a share in the benefits of the second industrial revolution—the robot revolution.

To be sure, my proposals are unprecedented, but so are automatic facto-

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ries. Undoubtedly the National Mutual Fund will require further study and perhaps some modifications. But it is firmly based on the principle of sound investment in an enormously productive new technology. To suggest that such a policy violates some basic law of economics is to completely misunderstand the entire history of the industrial revolution.

JAMES S. ALBUS
4515 Saul Rd.
Kensington, MD 20795
One thing seems clear: when automated factories make production jobs obsolete, some kind of new economic system will have to take the place of the job-oriented system we now have.

Dear Mr. Bova:

Alan Skinner's "Christmas Eve", in your January issue, rather effectively chides our government for its failure to advance space exploration. It is a point well taken, and anyone really interested in the future of the race has surely felt something akin to the frustration that drives Skinner's American astronauts into the hands of the Russians. However, science without ethics is never edifying, and the characters of "Christmas Eve" are not a very sympathetic lot for all this. Does one go to work at Peenemunde in hopes of someday setting foot on the Moon?

PAUL A. GILSTER
Univ. of North Carolina
Chapel Hill, NC 27514
Yes, obviously.

Dear Ben,

Re your Christmas-in-orbit editorial/plug—Christmas is incidental, though there may still be a few hangover victims from the first really *World* Con, L5 in '95!

NEIL REST
6256 N. Winthrop
Chicago IL 60660
But where will they hold the Lunacon that year?

Dear Mr. Bova,

I thoroughly enjoyed Jack Williamson's novelette "Stepson to Creation" (January 1977). You have often stated that science fiction should not merely restrict itself to prediction of technology advances in the future, but also contemplate the classical problem of how people react to their environment when confronted with newfound knowledge (or technology). This story, in my opinion, satisfied both criteria handily.

There is another feature about this story which made my day. It is the bittersweet optimism developed about genetic engineering. In these days of public outcry against the so-called catastrophic evils of this field, it is good to see somebody suggest that there is some hope for science and the human race (in the long run). Perhaps we can use genetic research to first discover more about ourselves, and then to use this knowledge to develop our race in a rational manner. Yes, it just might be that the meek shall inherit the Earth.

This story and others like "Children of Dune" are, in my opinion, first-rate, and I hope you bring us more of the same to the pages of Analog.

GARY ELFSTROM
3260 Southgate Rd.
Ottawa, Ont. KIV 8W9, Canada
We'll keep trying!

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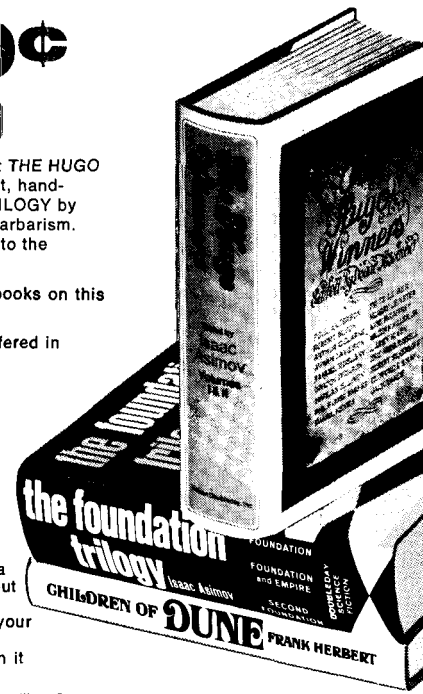

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